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REPORT
OF
THE DIRECTOR
OF THE
ROYAL OBSERVATORY, HONGKONG,
FOR THE YEAR
1920



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REMOTE STORAGE

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REPORT OF THE DIRECTOR OF THE ROYAL OBSERVATORY, HONGKONG, FOR THE YEAR 1920.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

Concreting the paths round the servants quarters was completed in the month of October.

II.—METEOROLOGICAL INSTRUMENTS.

Barometers.—A Marvin compensated syphon barometer was received on July 3. The tube was satisfactorily filled with mercury, but unfortunately it was broken in fitting it to its U tube and support. Two new tubes were ordered in August but have not yet been received.

Beckley Anemograph.—This instrument was oiled once a month, and the orientation of the head checked.

Dines-Barendell Anemograph.—The head was oiled once a month, and the spindle of the float cleaned and oiled once a week. The orientation of the head was checked monthly.

The mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1919 are given in the following table, together with the results for 1920 :—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor (Dines $\div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1919.	1920.
January,	2'10	1'67
February,	2'15	1'70
March,	2'17	1'67
April,	2'16	1'77
May,	2'19	1'98
June,	2'18	2'40
July,	2'29	2'09
August,	2'29	1'58
September,	2'29	1'53
October,	2'22	1'43
November,	2'14	1'36
December,	2'07	1'50
Year,	2'19	1'72

The scale value of the Dines-Baxendell instrument was determined in the month of May, 1918, by means of a gauge constructed at the Observatory. It appeared to be correct within the probable error of observation, which was about 1 mile at a velocity of 80 m.p.h. increasing to 3 miles at 10 m.p.h.

Gap Rock Anemograph.—In the month of July a Dines-Baxendell anemograph was erected at Gap Rock. The records indicate defects in the instrument which it is hoped it will be possible to remedy shortly.

Thermometers.—All thermometers in use were compared with the Kew Standard in winter and summer.

Richard Thermograph.—The base lines laid down on the Richard thermograms from the hourly readings of dry and wet bulb rotating thermometers show irregularities which it is difficult to attribute to the exposure, the thermograph being placed in a well ventilated double-thatched shed, 25 feet long by 20 feet wide, with gabled roof sloping from a height of 9 feet at the ridgepole to $3\frac{1}{2}$ feet at the eaves.

The thermograph is aspirated by a 12-inch fan distant $2\frac{1}{2}$ feet, which draws in the external air through a 14 inch pipe. The fan is operated by a contact on one of the electric dials closed from the 58th to the 60th minute of each hour. Prior to 1920, January 5, the contact was closed from the 59th to the 60th minute only, but it was found that one minute was not sufficient; on occasions the wet bulb pen was still falling at the 60th minute.

The registers are time-scaled electrically. An electro-magnet, operated by the hourly time signal, lifts the pens from the paper and clock work apparatus, adapted by Mr Evans in January, locks them until the 3rd minute when they are released and fall back on to the paper.

Sunshine Recorder.—In view of the interruption to the sunshine records caused by the Observatory wireless mast, a new sunshine recorder was obtained from Messrs J. Hicks and mounted on the south-west corner of the Main Building on January 6, 1921. Its records furnish the necessary corrections to those of the old instrument.

Peak Anemograph.—Signalman Osborne was in charge of this instrument from March 9 until May 31 when he resigned on account of ill health. He was replaced by Signalman McGrann on June 28. In the interval the sheets were changed daily by a computer from the Observatory.

It has not been possible to send an European Assistant to inspect the instrument as often as necessary, with result that the records have not always been satisfactory.

It is hoped that the meteorological observations at the Peak Signal Station, to which reference was made in last year's report, will be commenced shortly.

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura pluviograph, the amount of sunshine by a Campbell-Stokes universal sunshine recorder, and the relative humidity of the air by a small Richard hair hygograph. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of HongKong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal Features of the Weather.—The principal features of the weather in 1920 were:—

- (a) Barometric pressure below normal from the beginning of May to the beginning of August.
- (b) Rainfall much above normal in May, July and November.

Barometric pressure was considerably below normal in May, June, July, November and December and moderately above in January. The mean pressure for the year at station level was $29^{\text{ins.}} \cdot 814$ as against $29^{\text{ins.}} \cdot 842$ in 1919 and $29^{\text{ins.}} \cdot 843$ for the past 37 years. The highest pressure was $30^{\text{ins.}} \cdot 374$ on January 4th as against $30^{\text{ins.}} \cdot 398$ in 1919 and $30^{\text{ins.}} \cdot 509$ for the past 37 years. The lowest pressure was $29^{\text{ins.}} \cdot 208$ on July 19th as against $29^{\text{ins.}} \cdot 287$ in 1919 and $28^{\text{ins.}} \cdot 735$ for the past 37 years.

The temperature of the air was moderately below normal in April and considerably above normal in November and December. The mean temperature for the year was $72^{\circ} \cdot 0$ as against $72^{\circ} \cdot 2$ in 1919 and $71^{\circ} \cdot 8$ for the past 37 years. The highest temperature was $93^{\circ} \cdot 1$ on July 25th as against $92^{\circ} \cdot 2$ in 1919 and $97^{\circ} \cdot 0$ for the past 37 years. The lowest temperature was $45^{\circ} \cdot 1$ on January 5th as against $39^{\circ} \cdot 4$ in 1919 and $32^{\circ} \cdot 0$ for the past 37 years.

The rainfall was considerably above normal in May, July and November. The total for the year was $107^{\text{ins.}} \cdot 880$ as against $76^{\text{ins.}} \cdot 140$ in 1919, and $84^{\text{ins.}} \cdot 276$ for the past 37 years. The greatest fall in one civil day was $8^{\text{ins.}} \cdot 235$ on July 19th and the greatest in one hour was $1^{\text{ins.}} \cdot 435$ between 8.30 p.m. and 9.30 p.m. on September 12th.

The wind velocity was considerably below normal in January and October and moderately below in February, June and September. It was moderately above normal in May and July. The mean velocity for the year was 12.0 m.p.h. as against 11.4 m.p.h. in 1919 and 12.7 m.p.h. for the past 37 years. The maximum velocity for one hour, as recorded by the Beckley Anemograph, was 51 miles at 2 a.m. on July 31st as against 60 miles in 1919 and 103 for the past 37 years. The maximum squall velocity, as recorded by the Dines-Baxendell Anemograph, was at the rate of 61 m.p.h. at 10h. 58m. p.m. on July 30th as against 84 m.p.h. in 1919 and 105 m.p.h. for the past 11 years.

Rainfall at Four Stations.—In the following table the monthly rainfall for the year 1920 at the Observatory is compared with the fall at the Police Station, Taipo, the Botanical Gardens, and the Matilda Hospital, Mount Kellet:—

Months.	Observatory (Kowloon).	Police Station (Taipo).	Botanical Gardens (Hongkong).	Matilda Hospital (Hongkong).
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	0.065	0.11	.....	0.04
February, ...	2.640	5.44	3.10	2.66
March,	1.390	2.15	1.50	1.20
April,	8.265	7.03	7.88	7.43
May,	18.155	13.44	17.68	14.44
June,	15.555	18.82	17.90	13.78
July,	24.040	24.55	27.28	20.65
August,	10.975	28.35	14.74	8.93
September,...	11.750	7.90	17.22	12.40
October,	6.190	4.68	8.66	8.11
November, ...	7.045	7.50	7.16	7.78
December, ...	1.810	0.59	0.92	0.55
Year,...	107.880	120.56	124.04	97.97

Floods.—The heaviest rainfall occurred at the Observatory as follows:—

Period.	Amount.	Duration.	Greatest. fall in 1 hour.	Time.
d. h.	d. h.	inches.	hours.	d. h.
May..... 28 4 to	June... 2 16	10.330	76	1.17 May.....28 13
June ... 9 9 to	June... 12 18	10.500	43	1.20 June ...12 8
July..... 18 7 to	July... 21 2	12.695	49	1.12 July.....19 10
July..... 30 16 to	Aug.... 4 7	8.275	31	1.01 July.....31 16
Sept..... 10 22 to	Sept... 13 14	8.420	36	1.43 Sept.....12 21
Nov..... 17 8 to	Nov.... 18 9	4.860	19	0.64 Nov.....17 17

Typhoons.—The tracks of 16 typhoons and 4 of the principal depressions which occurred in the Far East in 1920 are given in two plates in the Monthly Meteorological Bulletin for December, 1920. The most noteworthy, as affecting Hongkong, were those of July 10-23 and July 29-31. The former apparently formed to the east of Luzon on July 10th, moved slowly NNW till the 13th, then more rapidly in a northerly direction until the 15th when it curved to westward and entered the coast near Wenchow on the morning of the 16th. It finally filled up in the Gulf of Tong King on the 23rd. Strong SW winds occurred at Hongkong from the 16th to 19th.

This storm was remarkable as being the only typhoon to enter the Eastern Sea in 1920, and for its long duration over the land.

The typhoon of July 29-31 formed in about latitude 17° N and longitude 115° E. Moving in a NNW direction it entered the coast about 70 miles to the west of Macao at about noon on the 31st. It caused a strong easterly gale at Hongkong.

A violent typhoon, of small diameter and abnormal track, formed to the west of Manila in the forenoon of August 31 and passed a few miles to the north of the Manila Observatory between 7 and 8 p.m. For the track of this typhoon I am indebted to the courtesy of the Director of the Philippines Weather Bureau, who states that it was the worst typhoon experienced in Manila since September, 1905.

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East for 6 a.m. of the 120th meridian, and the Daily Weather Report (containing meteorological observations, usually at 6h. and 14h., from about 40 stations in China, Indo-China, Japan, the Philippines, and Borneo) and daily weather forecasts for Hongkong to Gap Rock, the Formosa Channel, the south coast of China between Hongkong and Lamocks, and between Hongkong and Hainan, were issued as in former years. Copies of the map were exhibited on notice boards at the Hongkong Ferry Piers, Blake Pier, and the Harbour Office. One copy was sent daily to the Director of the Meteorological Observatory, Macao. Forty copies of the Daily Weather Report were distributed to various offices, etc., in the Colony, and a copy was sent daily to the Director of the Meteorological Observatory, Macao. Copies were sent every week to the Hydrographic Office, Bangkok.

A charge of \$10 a year is made for supplying private firms and individuals with the Daily Weather Report, and \$36 for the Weather Map. No maps were published on February 1, 4, March 7, 10, 13, April 15, 18, June 6, 8, July 18, September 5, and October 10, owing to the late arrival of the weather telegrams. On many other occasions the map, though published, contained but meagre information.

The weather forecast is telegraphed daily to the Cape d'Aguilar Wireless Station in time for distribution at 1 p.m. It is broadcasted again at 5 p.m.

Monthly Meteorological Bulletin.—The Monthly Meteorological Bulletin, which includes the Daily Weather Report, was published as usual, and distributed to the principal observatories and scientific institutions in different parts of the world.

Miscellaneous Returns.—A monthly abstract of observations made at the Observatory is published in the Government Gazette, and daily, monthly, and yearly results are published in the Blue Book in the form suggested by the London Meteorological Office for the British Colonies.

The monthly departures from normal of the barometric pressure at four China Coast Ports are communicated to the Commonwealth Meteorologist, Melbourne, in connection with long range weather forecasts. Monthly meteorological returns are forwarded to the Meteorological Magazine, and annual returns to the Stock Exchange Official Intelligence, and the Colonial Office List.

V.—WEATHER TELEGRAMS, FORECASTS, AND STORM WARNINGS.

Daily Weather Telegrams.—In the month of June representations were made to the Superintendent of the Eastern Extension Telegraph Co. on the subject of delays in the transmission of daily weather telegrams. Mr Airey took up the matter energetically, with the result that now observations from the Philippines are received in time for insertion in the Daily Weather Map. The Vladivostock and Indo-China observations also arrive in time fairly regularly, and the Japanese observations occasionally.

Occasionally belated weather telegrams are received from Central and South China, but as a rule the observations from these districts are posted in batches to Hongkong.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hongkong :—Amoy, Canton, Macao, Phulien, Sharp Peak, and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre.

The extra 9 p.m. telegram, from Swatow, kindly sanctioned by the Chinese Telegraph Administration during the typhoon season, was frequently not received.

Wireless Weather Telegrams.—There has been but a poor response to the Marconi Company's circular and the Observatory Notice to Mariners respecting wireless weather telegrams referred to in last year's report.

The following table gives the monthly number of ships, of different nationalities, from which wireless meteorological messages have been received, and the number of messages received, (each arrival and departure is counted separately).

Month.	<i>British (including H.M. Ships).</i>		<i>Dutch.</i>		<i>Japanese.</i>		<i>Other Nationalities.</i>	
	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.
January,	4	11	2	3	...	...	...	...
February,	6	11	5	6	...	...	...	...
March,	3	6	3	4	...	...	1	1
April,	2	4	4	5	3	7	1	1
May,	3	6	2	3	1	1	...	...
June,	7	10	7	11	2	3	1	1
July,	12	17	7	14	5	6	...	...
August,	7	10	3	5	1	1	...	...
September, ...	4	8	5	10	3	6	...	...
October,	6	7	5	8	5	10	...	...
November,	5	8	1	2	2	5	...	...
December,	5	6	4	5	3	6	...	...
Totals 1920,...	64	...	48	...	25	...	3	...
Totals 1919,...	17	...	36	...	6	...	2	...
Totals 1918,...	...	...	41	...	14	...	...	...
Totals 1917,...	...	...	93	...	37	...	...	...
Totals 1916,...	...	...	95	...	60	...	...	...

Results of Weather Forecasts.—The results of the comparison of the daily weather forecasts with the weather subsequently experienced are given below, with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1915	54	37	8	1
1916	67	29	3	1
1917	67	29	4	0
1918	71	26	3	0
1919	71	27	2	0
1920	64	30	5	1

No forecasts were issued on February 4 and March 13, owing to lack of telegraphic information.

The forecast comprises wind direction, wind force, and weather.

Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings.—At the request of the Chamber of Commerce the Hongkong government adopted the China Seas Storm Signal Code from 1920, June 1, in place of the Hongkong Non-Local Code introduced in 1917.

The following Ports are warned by a telegraphic adaptation of this code :—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Pakhoi, Hoihow, Phulien, Taihoku, Manila, Labuan, and Singapore.

As the China Seas Code includes a time signal at the mast head which formerly was reserved for the Local Typhoon Signals, it became necessary to select a new site for the Local Signals.

A Committee composed of the Colonial Secretary, the Harbour Master, the Director of the Observatory, the President of the Chamber of Commerce and representatives of Messrs. Jardine, Matheson & Co., Ltd. and Messrs. Butterfield & Swire was therefore appointed by His Excellency the Governor to consider the matter. At the suggestion of the Director of the Observatory the Committee recommended that the Local Typhoon Signals should be transferred to the Observatory wireless mast. This was approved and the necessary gibbet and hoisting gear were installed by the Public Works Department. The Old Equatorial Dome was enlarged to accommodate the Local Typhoon symbols.

As the Observatory is farther from the town than the Signal Hill the height of the symbols was increased to 8 feet and the other dimensions increased in proportion.

The local day signals are repeated at the Harbour Office, H.M.S. *Tamar*, Green Island, the Godown Company (Kowloon), Lyemun, and Lai Chi Kok.

The local night signals are exhibited on the Observatory Wireless Mast and repeated on the tower of the Kowloon Railway Station, on H.M.S. *Tamar*, and at the Harbour Office.

A translation of the non-local and local storm warnings is exhibited at the Harbour Office, the General Post Office and the Star Ferry Piers, and also sent to the Cape d'Aguilar Wireless station

which broadcasts the message at about noon and repeats it every two hours until midnight. If a second warning is issued during the day, the later warning is substituted.

When a local storm warning is displayed at the Observatory a cone is exhibited at several outlying stations for the benefit of native craft and passing ocean vessels.

In the following table is given the number of hours the local signals were hoisted in each of the years 1912-1920 :—

Year.	Red Signals.	Black Signals.	Bombs. *
	Number of hours hoisted.		Number of times fired.
1912	151	164	...
1913	146	189	1
1914	146	178	...
1915	64	120	...
1916	70	201	1
1917	102	36	...
1918	33	102	1
1919	78	105	1
1920	107	156	...

The figures in the above table included the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signals indicate that a depression exists which may cause a gale at Hongkong within 24 hours. The black signals indicate that a gale is expected at Hongkong.

Prior to July, 1917, the red signals indicated that the centre of the typhoon was believed to be more than 300 miles distant, and the black less than 300 miles; the returns for 1912-1916 are therefore not strictly comparable with those for 1917-1920.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &c.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 170 ships operating in the Far East. These logs, representing 5,872 days' observations, have been utilised for verifying typhoon tracks. The corresponding figures for the years 1919 were 81 and 2,587.

* Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

Comparison of Barometers.—During the year 170 comparisons of ships' barometer have been made by means of observations taken when in harbour. Several direct comparisons of barometers for shipmasters and various persons in the Colony have been made at the Observatory.

VII.—MAGNETIC OBSERVATIONS.

The mean values of the magnetic elements for the years 1919 and 1920 were as follows:—

	1919.	1920.
	° ' "	° ' "
Declination (west)	0 19 50	0 20 45
Dip (north)	30 47 30	30 46 22
Horizontal Force (C. G. S. unit)	0·37171	0·37191
Vertical Force (C. G. S. unit) ..	0·22151	0·22146
Total Force (C. G. S. unit) ...	0·43270	0·43286

The series of magnetic observations made in the old magnetic hut since 1884 terminated in December, the site having been taken over by Government for European Assistants' Quarters. Observations in the new hut cannot be made until the building operations are finished.

Comparisons between Magnetometers Elliott 55 and 83 and Dip Circle Dover 71, in the old and new huts, were made between 1919 August and 1920 June, as opportunity offered.

The mean results of the observations are given below:—

Horizontal Force.

Elliott 55 and vibration magnet 55A in old hut.	Elliott 83 and vibration magnet 83 in new hut.	(a)—(b).	Number of observations.
(a).	(b).		
0·37162	0·37216	-- 0·00054	18
Elliott 55 and vibration magnet 55A.			
in old hut.	in new hut.		
(a).	(b).		
0·37201	0·37200	+ 0·00001	5

7 Comparisons made in the year 1916 in the old hut gave:—

$$\begin{array}{rcl} \text{Elliott 55 and} & & \text{Elliott 83 and} \\ \text{vibration magnet 55A.} & - & \text{vibration magnet 83.} \\ & & = + 22 \gamma \end{array}$$

It should be mentioned that prior to the comparisons in 1919-1920 the lens and scale of magnet 83 were transposed, for convenience of observing. The lens was originally at the north end of the magnet.

After this alteration the value of $\log \pi^2 \kappa$ at 0°C was found to be $3.44611 \pm .00004$ as against 3.44643 determined at Kew in 1915 and used in the 1916 comparisons. The value of P from the 18 observations in 1919-1920 was $+7.58 \pm .07$; whereas the value used in 1916, as derived from 7 observations was $+7.78 \pm .08$.

Declination.

Elliott 55 and vibration magnet 55A in old hut.	Elliott 83 and vibration magnet 83 in new hut.	(a)—(b)	Number of observations.
(a)	(b)		
20' 6" W.	19' 36"	+ 30"	22

Elliott 83 and vibration magnet 83 in old hut.	Elliott 55 and vibration magnet 55A in new hut.		
(a)	(b)		
20' 22" W.	20' 54"	— 32"	6

Dip.

Dover 71 in old hut.	in new hut.		
(a)	(b)		
30° 46' 48" N.	30° 47' 75" N.	— 1' 27"	16

VIII.—TIME SERVICE.

Time Ball.—Prior to 1920, January 1, the Time Ball on Kowloon Signal Hill was dropped daily at 1 p.m. (120th Meridian Time) It is now dropped at 10 a.m. and 4 p.m. daily, except on Saturdays when it is dropped at 10 a.m. and 1 p.m., and on Sundays and Holidays when it is dropped at 10 a.m. only.

The Ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

When the Time Ball is out of order the above routine is carried out with the flag "z", on the Storm Signal mast.

Time Signals are also given at night by means of three white lamps mounted vertically on the Observatory wireless mast. From 8h. 56m. 0s. to 9h. 0m. 0s. p.m. the lamps are extinguished momentarily at the even seconds, except at the 2nd, 28th, 50th, 52nd, and 54th of each minute. The hours refer to Hongkong Standard Time (8 hours East of Greenwich).

The ball was dropped successfully 651 times. There were 6 failures attributable to electrical and mechanical defects or to the negligence of the computers in charge at the tower. The days on which the ball failed to drop were:—February 19, March 9, April 26, May 16 and September 20 (twice).

The ball was not raised on January 18 (10h), February 18 (10h), March 12 (10h), May 19 (10h), July 30 (16h), 31 (10h & 16h), and September 27 (10h), owing to repairs, or the prevalence of high winds.

The ball fell with an error of 0·3 sec. or less on 562 occasions, and with an error of 0·4 sec. or 0·5 sec. on 76 occasions. Errors of 0·6 sec. occurred 10 times, of 0·9, 1·0 and 1·5 sec. once each. The mean probable error of the Time Ball was $\pm 0\cdot18$ sec. The monthly values for the past 5 years are given below :—

Month.	Probable Error of the Time Ball.				
	1916	1917	1918	1919	1920
January,	$\pm 0\cdot15$	$\pm 0\cdot17$	$\pm 0\cdot11$	$\pm 0\cdot24$	$\pm 0\cdot17$
February,	$\cdot28$	$\cdot10$	$\cdot13$	$\cdot20$	$\cdot30$
March,	$\cdot17$	$\cdot11$	$\cdot15$	$\cdot12$	$\cdot21$
April,	$\cdot18$	$\cdot18$	$\cdot10$	$\cdot19$	$\cdot15$
May,	$\cdot10$	$\cdot17$	$\cdot12$	$\cdot14$	$\cdot17$
June,	$\cdot17$	$\cdot10$	$\cdot14$	$\cdot14$	$\cdot13$
July,	$\cdot10$	$\cdot21$	$\cdot11$	$\cdot13$	$\cdot22$
August,	$\cdot10$	$\cdot11$	$\cdot26$	$\cdot15$	$\cdot11$
September,	$\cdot11$	$\cdot10$	$\cdot16$	$\cdot10$	$\cdot24$
October,	$\cdot13$	$\cdot10$	$\cdot12$	$\cdot15$	$\cdot15$
November,	$\cdot13$	$\cdot10$	$\cdot12$	$\cdot14$	$\cdot19$
December,	$\cdot11$	$\cdot10$	$\cdot14$	$\cdot12$	$\cdot13$
Means,	$\pm 0\cdot14$	$\pm 0\cdot13$	$\pm 0\cdot14$	$\pm 0\cdot15$	$\pm 0\cdot18$

Time Signals by Wireless Telegraphy.—In addition to the time signals given by the Time Ball, signals are sent at noon and at 21h. by wireless telegraphy *viâ* Cape d'Aguilar. Particulars of the programme are given in the 1918 Report. The service has been interrupted rather frequently by circumstances over which the Observatory has no control. It is to be transferred to Stonecutters when the necessary cable between this Station and the Observatory is laid.

Wireless Receiving Set.—A receiving set was installed at the Observatory by the Naval Authorities in November, and wireless Time Signals have since been regularly observed from Manila and Funabashi (Tokio), though the observations have frequently been spoilt by other stations working in contravention of paragraph 3 of Article 45 of the Service Regulations appended to the International Radiotelegraph Convention of 1912. The Shanghai signals are still not heard.

It is hoped that the Director may soon have an opportunity of discussing details of a uniform scheme of Wireless Time Signals with the Directors of other Observatories in the Far East.

Transit Instrument.—Observations for time were made daily with the 3 inch transit instrument and the Hipp tape chronograph by the Chinese computers, weather permitting.

The number of observations in the years 1919 and 1920 were as follows :—

	1919	1920
Transits,	1,321	985
Level determination,	676	557
Azimuth,	23	20
Collimation,	22	20

Transits of the Sun were utilized occasionally during 1920.

The azimuth and collimation determinations were made by the Chief and First Assistants from observations of the old south mark.

Clocks.—The losing rate of the Standard Sidereal clock, Dent No. 39741, varied from -0.23 sec. on July 9 (Barometer $20^{\text{ins}}.63$ Temperature $84^{\circ}.3$) to -0.76 sec. on November 11 (Barometer $29^{\text{ins}}.82$ Temperature $78^{\circ}.3$).

The rate during cloudy periods was usually derived from the formula :—

$r = -0s.792 + 0s.575 (b - 29^{\text{ins}}) + 0s.00021 (t - 50^{\circ})$ where r is the computed losing rate, and b and t the mean barometric pressure and temperature, respectively, for the preceding 24 hours.

In the following table is given the excess of the observed over the computed error after cloudy periods during 1920 :—

Date 1920.		Interval without observations.	Excess of observed over computed error.
			<i>secs.</i>
February	16,	22 days	+ 1.01
March	18,	30 "	— 0.29
"	24,	3 "	+ 0.28
April	2,	3 "	— 0.32
"	16,	12 "	+ 0.31
May	10,	18 "	+ 0.58
June	2,	7 "	+ 0.51
"	16,	6 "	— 0.09
"	27,	5 "	— 0.26
July	5,	4 "	+ 0.49
"	23,	6 "	— 0.42
August	6,	8 "	+ 0.35
"	12,	4 "	+ 0.10
"	20,	4 "	— 0.05
September	1,	8 "	+ 0.04
"	14,	3 "	— 0.19
"	24,	5 "	+ 0.43
October	9,	4 "	+ 0.11
November	8,	4 "	— 0.56
December	2,	4 "	— 0.45
"	2,	5 "	— 0.36

The clock tripped two seconds on September 15. It was cleaned and the contact springs re-adjusted on September 24.

The Dent Mean Time clock (No. 39740) was used throughout the year for dropping the Time Ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10 a.m. by the electric regulating apparatus, and its daily rate kept below 0.5 sec. by the addition or removal of weights from the pendulum.

Chronometer Dent No. 40917 is on loan to the Cape d'Aguilar Wireless Station, and chronometer Dent No. 39946 to the Peak Signal Station. Chronometer Woolf No. 5232 was forwarded for safekeeping to the Observatory by the Hon. Colonial Treasurer in August, 1920, and has been kept wound and rated since.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light and Power Co., Ltd., by a rotary converter. Two batteries of 10 Hart cells of the S. G. 9-plate pattern were set up in May to replace the old Tudor Battery, all the cells of which had become unserviceable except two. These were used for the filament of the valve of the wireless receiving set. A battery of 30 Pritchett cells was set up at the same time to supply high tension current to the valve.

Since the re-wiring mentioned last year, and the acquisition of sufficient battery power, the internal Time Service has been extremely satisfactory.

The occasional trouble with the Time Ball, arising from earth leakage or want of adjustment of the releasing trigger, also appears to have been overcome. There has been no failure since September 27.

IX.—UPPER AIR RESEARCH.

When on leave of absence in England the Director was requested to confer with the Air Ministry with a view to advising the Hong-kong Government what it was necessary to do on the meteorological side to assist aviation in the Colony.

The Director visited the upper air research stations at Benson and South Farnborough, and also conferred with the Director of the London Meteorological Office and the Superintendent of Instruments several times.

Facilities for obtaining the necessary information were courteously accorded by Sir Napier Shaw and the Superintendents of the above Departments, to whom the thanks of this government are due.

As result of his enquiries the Director recommended the purchase of the following outfit :—

Two theodolites.
Ten Dines Meteorographs.
One Microscope for measuring meteorograms.
Ten hygrometers.
400 Pilot balloons.
Two Manheim slide rules.
Calibrating outfit for meteorographs.

The Hongkong Government however were unable to sanction the appointment of the Professional Assistant and Mechanic necessary for carrying out a programme of upper air research with the above instruments, and requested the Director to amend his recommendations accordingly. This was done by omitting the meteorographs, microscope and calibrating outfit. The remaining items were sanctioned, and ordered through the London Meteorological Office in August. They have not yet been received.

Sir Napier Shaw wrote to the Director as follows :—

I cannot find that there is any immediate prospect of developing air routes on the line of which Hongkong will lie. It is quite clear that if routes were to be developed between Japan and Australia or between India and Japan, Hongkong would be a centre of information of the most vital importance, but I am not aware that projects of that kind are being actively prosecuted. We have therefore to deal with the general meteorological importance of the position of Hongkong and of that there can be no question, and what will be useful for aviation when it materialises will be in the meantime useful for the study of cyclones and other atmospheric visitations of Hongkong.

While therefore I cannot say that aviators will forthwith claim your assistance, meteorologists will look to you as the natural centre of information for the region between Calcutta and the Philippines and between the equator and latitude 50°.

It is very desirable that you should be equipped with means of exploration of the upper air and provided with facilities for acquiring information from a network of stations in the region specified.

X.—MISCELLANEOUS.

Seismograph Installation.—When on leave of absence the Director visited the Oxford University Observatory to confer with Professor Turner, Chairman of the Seismological Committee of the British Association for the Advancement of Science, on the subject of a seismograph outfit for Hongkong.

A Milne-Shaw machine with North and East components, and a smoked paper machine for visual observations were decided upon. The latter arrived in Hongkong on January 25, 1921.

The Director visited Mr. J. J. Shaw's Seismological Observatory at Birmingham and had the opportunity of seeing one of his seismographs dismantled and re-assembled. He also discussed several points in connection with the construction and maintenance of a two component outfit for Hongkong.

Mr. Shaw has improved the Milne Seismograph by electromagnetic damping and by magnifying the movements of the boom (shorter than the Standard Milne boom) by reflecting a beam of light from an exceedingly light, finely pivoted mirror of half-metre focus, coupled to the end of the boom by an equally light, ingenious, and almost frictionless device. Improved calibrating and adjusting arrangements are also provided.

Staff.—No change occurred in the European Staff during the year. During the absence on leave of the Director, from March 2 to December 4, Mr. C. W. Jeffries, the Chief Assistant, acted as Director and Mr. B. D. Evans, First Assistant, acted as Chief Assistant.

Leong Kwok Hoon, 5th grade telegraphist, resigned on May 31, and was replaced by Ko Chuck Shan, who, being found unsuited to the post, was superseded by Ip Chun Woo on August 1.

Chan Iu Fong was promoted to the post of IVth grade telegraphist at the Post Office on December 9 and was replaced by Ng Hung Kui on December 24.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows:—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1911	23 353.02	1,565.47	.....
1912	22,595.08	.....	757.94
1913	24,255.49	1,660.41	.....
1914	25 398.31	1,142.82	.....
1915	23,233.12	.....	2,165.19
1916	21,977.78	.....	1,255.34
1917	26,890.50	4,192.72	.....
1918	20,028.24	.....	6,862.26
1919	23,450.57	3,422.33	.....
1920	25,965.66	2,515.09	.....

Acknowledgements.—Acknowledgements are here made to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs authorities, for daily observations and extra observations during typhoon weather, to the Telegraph Companies for transmitting the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by wireless telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the manner in which they have carried out their respective duties.

T. F. CLAXTON,
Director.

1921, February 18.

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REPORT OF THE DIRECTOR OF THE ROYAL OBSERVATORY, HONGKONG, FOR THE YEAR 1921.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

The old magnetic hut was pulled down early in the year and quarters for the European assistants built on the site. They were completed in September.

II.—METEOROLOGICAL INSTRUMENTS.

Barometers.—The glass tube for the Marvin compensated syphon barometer was received in December and the instrument set up in February, 1922. The circuit for the seismograph minute time break apparatus is led through two contact springs on the face of the barograph clock. When the minute hand arrives at $59\frac{1}{2}$ minutes it breaks this contact and makes contact for one minute through a third spring placed above the other two. The current instead of passing through the seismograph time-break coil thus passes through the coil of an electric hammer which time-scales the barogram every hour. Diverting the current from the seismograph at the 60th minute also serves to identify the minute breaks on the seismograms.

Beckley Anemograph.—This instrument was oiled and the orientation of the vane checked once a month.

Dines-Baxendell Anemograph.—The bearings of the vane were oiled and its orientation checked once a month. The spindle of the float was cleaned and oiled once a week. In November the instrument was carefully calibrated at low velocities by a pressure gauge constructed locally. The gauge was tilted about 80° from the vertical in order to obtain a measurable displacement of the water for a velocity as low as 5 miles an hour. The observations indicated that the float was too light; shot were therefore placed in the cup on the spindle until the float sank to the correct level. The criterion being that the line produced through the observations of the pressure gauge, plotted against the corresponding pressures read from the anemogram, should pass through the zero of the anemogram scale.

The mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1920 are given in the following table, together with the results for 1921.

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor (Dines $\div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1920.	1921.
January,	1.87	1.49
February,	1.91	1.46
March,	1.93	1.60
April,	1.93	1.73
May,	1.99	1.69
June,	2.02	1.77
July,	2.08	1.92
August,	2.04	1.88
September,	2.03	1.83
October,	1.97	1.78
November,	1.89	1.83
December,	1.85	1.96
Year,	1.96	1.74

Gap Rock Anemograph.—This instrument was dismantled and brought to the Observatory to be overhauled in November. A leak in the float was repaired, the vane lightened and a vertical tail added, with “stream line” cross section as recommended by the London Meteorological Office.

Owing to its exposed position the vane was designed to withstand exceptionally heavy gales, with result that, owing to its weight, it was very sluggish. This caused erroneous records not only of direction but velocity also, as the true velocity is only recorded when the vane is pointing in the direction from which the wind blows. It follows that in estimating the amount of turbulence in the atmosphere from records of Dines Anemographs the sensibility of the vane must be taken into consideration, the alternate lulls and gusts shown on the anemograms being partly due to the vane not responding to changes of wind direction, and to the fact that the vane is continually oscillating on either side of the wind direction, only remaining parallel to the wind for a short time.

Thermometers.—All thermometers in use were compared with the Kew Standard in winter and summer.

Richard Thermograph.—This instrument worked satisfactorily during the year, though the base lines as laid down from the hourly eye observations of rotating thermometers still show irregularities, except on dull days with small range of temperature. The period during which the fan automatically aspirates the thermometers has been further increased to 5 minutes *i.e.* from the 55th to the 60th minute of each hour. The effect of the fan on the dry and wet bulb readings for the year 1921 is being measured. The results may modify the figures given on page 16 of the 1918 report.

III.—METEOROLOGICAL OBSERVATION AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura pluviograph, the amount of sunshine by two Campbell-Stokes universal sunshine recorders, and the relative humidity of the air by a small Richard hair hygograph. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hongkong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal features of the Weather.—The principal features of the weather in 1921 were:—

- (a) Heavy rainfall from April 27 to July 6, during which period 59 inches of rain fell on 59 days; and a drought from September 9 to the end of the year when only 1 inch of rain fell.
- (b) Abnormally low wind velocity in March, increasing gradually to normal in July.

Barometric pressure was considerably above normal in January, July and October, and considerably below in May, June and August. The mean pressure for the year at station level was $29\cdot848^{\text{ins.}}$ as against $29\cdot814^{\text{ins.}}$ in 1920 and $29\cdot843^{\text{ins.}}$ for the past 38 years. The highest pressure was $30\cdot323^{\text{ins.}}$ on January 14 as against $30\cdot374^{\text{ins.}}$ in 1920 and $30\cdot509^{\text{ins.}}$ for the past 38 years. The lowest pressure was $29\cdot319^{\text{ins.}}$ on July 24, as against $29\cdot208^{\text{ins.}}$ in 1920 and $28\cdot735^{\text{ins.}}$ for the past 38 years.

The temperature of the air was moderately above normal in February, March, April, August and December and moderately below in January. The mean temperature for the year was $72^{\circ}\cdot2$ as against $72^{\circ}\cdot0$ in 1920 and $71^{\circ}\cdot8$ for the past 38 years. The highest temperature was $92^{\circ}\cdot2$ on August 22 as against $93^{\circ}\cdot1$ in 1920 and $97^{\circ}\cdot0$ for the past 38 years. The lowest temperature was $44^{\circ}\cdot0$ on February 4 as against $45^{\circ}\cdot1$ in 1920 and $32^{\circ}\cdot0$ for the past 38 years.

The rainfall was very considerably above normal in May and moderately above normal in March, August and September. It was considerably below normal in April, October, November and December. The total for the year was $97\cdot34^{\text{ins.}}$ as against $107\cdot88^{\text{ins.}}$ in 1920, and $84\cdot62^{\text{ins.}}$ for the past 38 years. The greatest fall in one civil day was $6\cdot06^{\text{ins.}}$ on September 3 and the greatest in one hour was $3\cdot25^{\text{ins.}}$ between 1.30 p.m. and 2.30 p.m. on May 31.

The wind velocity was considerably below normal in January, March, April, May and October. In July it was normal and in the remaining months it was slightly below normal. The mean velocity for the year was $10\cdot7$ m.p.h. as against $12\cdot0$ m.p.h. in 1920 and $12\cdot7$ m.p.h. for the past 38 years. The maximum velocity for

one hour, as recorded by the Beckley Anemograph, was 51 miles at 11 a.m. on July 24 as against 51 miles in 1920 and 108 for the past 38 years. The maximum squall velocity, as recorded by the Dines-Baxendell Anemograph, was at the rate of 69 m.p.h. at 5h. 53m. a.m. on September 3 as against 61 m.p.h. in 1920 and 105 m.p.h. for the past 12 years.

Rainfall at Four Stations.—In the following table the monthly rainfall for the year 1921 at the Observatory is compared with the fall at the Police Station, Taipo; the Botanical Gardens; and the Matilda Hospital, Mount Kellet:—

Months.	Observatory (Kowloon).	Police Station (Taipo).	Botanical Gardens (Hongkong).	Matilda Hospital (Hongkong).
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	0·195	0·19	0·28	0·31
February, ...	1·040	1·48	1·20	0·80
March,	4·505	5·70	4·74	3·74
April,	2·820	2·70	3·01	2·95
May,	33·785	35·49	33·50	29·67
June,	14·740	20·32	16·59	19·83
July,	11·875	15·47	13·88	11·30
August,	15·445	15·27	15·95	12·95
September,...	12·100	16·31	15·77	10·49
October,	0·395	0·80	0·15	0·24
November, ...	0·220	0·88	2·43	0·25
December, ...	0·220	0·02	0·33	0·32
Year....	97·340	114·63	107·83	92·85

Floods.—The heaviest rainfall occurred at the Observatory as follows:—

<i>Period.</i>				<i>Amount.</i>	<i>Duration.</i>	<i>Greatest fall in 1 hour.</i>	
						<i>Amount.</i>	<i>Time.</i>
d.	h.	d.	h.	inches.	hours.	inches.	d. h.
May...	4 23	to	May 5 23	4·14	23	1 04	May... 4 23
May...	9 10	to	May 10 13	5·10	17	2 06	May... 9 16
May...	14 12	to	May 18 6	6·56	46	1·76	May... 17 12
May...	22 6	to	May 28 4	13·10	74	1·56	May... 24 4
May...	31 13	to	May 31 16	3·51	3	3·25	May... 31 14
June	29 9	to	July 6 21	10·43	47	1·23	July... 2 13
Aug...	24 4	to	Aug. 26 18	6 09	18	1·52	Aug... 26 14
Aug...	30 2	to	Sept. 7 14	16·38	69	1 08	Aug... 30 8

Typhoons.—The tracks of 21 typhoons and 11 of the principal depressions which occurred in the Far East in 1921 are given in two plates in the Monthly Meteorological Bulletin for December 1921.

The Captain of the S. S. *Anamba* reports a typhoon in latitude $15^{\circ}23'$ N. and longitude $110^{\circ}33'$ E. on July 16. The wind veered from N at 10 p.m. on the 15th to SE by 6 a.m. on the 16th and SSW by 8 a.m. The force increased from 1 at 4 p.m. on the 15th to 11 at 4 a.m. on the 16th and then decreased to 7 by 9 a.m. A note adds that the vessel drifted approximately $N\ 29^{\circ}\ E$ 44 miles in the typhoon. The *Euryalus*, 120 miles to the northward, had a steady barometer with light to moderate ENE winds.

On July 22 a secondary formed in the southern portion of a depression to the east of Luzon which was travelling northward. The secondary moved westward and passed near Pakhoi on July 25. It caused a gale at Hongkong on July 24.

On September 2 a secondary formed in the north-east portion of a depression in the China Sea, whose direction of motion was uncertain. The secondary developed into a typhoon and caused a gale at Hongkong. It filled up near Woochow on September 3.

The attention of meteorologists is drawn to these three typhoons. No indication of the first was shown on the weather map. This Observatory had no knowledge of its existence till nearly 8 months later, when the log of the *Anamba* was received by the courtesy of the Director of the Philippines Weather Bureau. Its track is very uncertain. It was evidently short lived and of small diameter. Both of the others absorbed the primary cyclone, and one formed in the southern portion of it while the other formed in the north-east portion. They were evidently analogous to the typhoon which caused so much damage to Hongkong on September 18, 1906.

The formation of these secondaries in the China Sea, where there are no observing stations, adds to the difficulty of the weather forecaster, and emphasises the importance of wireless weather telegrams from ships. In their own interests every vessel with a wireless outfit should send observations in accordance with the Notice to Mariners which is supplied to all shipping companies in Hongkong.

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East for 6 a.m. of the 120th meridian, and the Daily Weather Report (containing meteorological observations, usually at 6h. and 14h., from about 40 stations in China, Indo-China, Japan, the Philippines, and Borneo) and daily weather forecasts for Hongkong to Gap Rock, the Forinosa Channel, the south coast of China between Hongkong and Lanooks, and between Hongkong and Hainan, were issued as in former years. Copies of the map were exhibited on notice boards at the Hongkong Ferry Piers, Blake Pier, and the Harbour Office. One copy was sent daily to the Director of the Meteorological Observatory, Macao. Forty copies of the Daily Weather Report were distributed to various offices, etc., in the Colony, and a copy was sent daily to the Director of the Meteorological Observatory, Macao. Copies were sent every week to the Hydrographic Office, Bangkok.

The question of publishing the Daily Weather Report and Map in the "Daily Bulletin" (a local publication devoted principally to cable news) was raised, but as it required a high speed and costly lithographic plant at the Observatory, the project was left in abeyance.

A charge of \$10 a year is made for supplying private firms and individuals with the Daily Weather Report, and \$36 for the Weather Map. No maps were published on January 23, 24 and 26, February 27, March 11, and May 15, owing to the late arrival of the weather telegrams. On several other occasions the map, though published, contained but meagre information.

The weather forecast is telegraphed daily to the Cape d'Aguilar Wireless Station in time for distribution at 1 p.m. It is broadcast again at 5 p.m.

Monthly Meteorological Bulletin.—The Monthly Meteorological Bulletin, which includes the Daily Weather Report, was published as usual, and distributed to the principal observatories and scientific institutions in different parts of the world.

Monthly Seismological Bulletin.—The publication of a monthly seismological bulletin, giving particulars of earthquakes recorded by the Milne-Shaw seismograph, was commenced in October.

Miscellaneous Returns.—A monthly abstract of observations made at the Observatory is published in the Government Gazette, and daily, monthly, and yearly results are published in the Blue Book in the form suggested by the London Meteorological Office for the British Colonies. The monthly departures from normal of the barometric pressure at four China Coast Ports are communicated to the Commonwealth Meteorologist, Melbourne, in connection with long range weather forecasts. Monthly meteorological returns are forwarded to the Meteorological Magazine, and annual returns to the Stock Exchange Official Intelligence, the Colonial Office List, and Whitaker's Almanack.

V.—WEATHER TELEGRAMS, FORECASTS, AND STORM WARNINGS.

Daily Weather Telegrams.—The improvement in this service mentioned last year continues, but occasionally the observations from Japan and Indo-China still arrive too late for insertion in the Daily Weather Map.

A welcome addition to the list of reporting stations is Yap, in longitude 138° 08' E and latitude 9° 29' N. Through the courtesy of the Director of the Philippines Weather Bureau observations from this station have been received since March 23, except when communication has been interrupted. While on a visit to the Zikawei Observatory in the Spring the Director discussed with Father Froc the possibility of obtaining daily weather telegrams from Hankow. Owing however to unforeseen difficulties the service has not yet commenced. Occasionally belated weather telegrams are received from Central and South China, but as a rule the observations from these districts are posted in batches to Hongkong. The prompt receipt of telegrams from these districts would be of great assistance in weather forecasting, particularly in the winter months.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hongkong:—Amoy, Canton, Macao, Phulien, Sharp Peak, and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The extra 9 p.m. telegram, from Swatow, kindly sanctioned by the Chinese Telegraph Administration during the typhoon season, was seldom received.

Wireless Weather Telegrams.—There has been but a poor response to the Marconi Company's circular and the Observatory Notice to Mariners respecting wireless weather telegrams referred to in the 1919 report. Less than 10% of the ships within range sent weather telegrams to the Observatory during the year.

The following table gives the monthly number of ships, of different nationalities, from which wireless meteorological messages have been received, and the number of messages received, (each arrival and departure is counted separately).

Month.	<i>British (including H.M. Ships).</i>		<i>Dutch.</i>		<i>Japanese.</i>		<i>Other Nationalities.</i>	
	No. of ships.	No. of mes- sages.	No. of ships.	No. of mes- sages.	No. of ships.	No. of mes- sages.	No. of ships.	No. of mes- sages.
January,	3	6	2	3	1	1	1	1
February,	4	5	5	5	3	8	...	...
March,	3	8	5	5	1	1	...	...
April,	6	12	2	3	1	1	...	...
May,	8	15	4	4	5	7	6	7
June,	12	22	6	13	4	7	7	13
July,	19	40	10	20	5	8	3	4
August,	12	23	8	11	5	9	2	4
September, ...	16	46	14	26	3	6	1	1
October,	14	32	6	9	2	4	...	...
November,	12	27	12	17	6	16	1	1
December,	12	31	10	14	4	9	...	...
Totals 1921,...	121	...	84	...	40	...	21	...
Totals 1920,...	64	...	48	...	25	...	3	...
Totals 1919,...	17	...	36	...	6	...	2	...
Totals 1918,...	...	...	41	...	14	...	...	...
Totals 1917,...	...	...	93	...	37	...	...	...
Totals 1916,...	...	...	95	...	60	...	...	...

Results of Weather Forecasts.—The results of the comparison of the daily weather forecasts with the weather subsequently experienced are given below, with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1916	67	29	3	1
1917	67	29	4	0
1918	71	26	3	0
1919	71	27	2	0
1920	64	30	5	1
1921	65	30	5	0

No forecasts were issued on January 23, 24, 26, February 27 and March 11, owing to lack of telegraphic information.

The forecast comprises wind direction, wind force, and weather.

Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings. At the request of the Chamber of Commerce the Hongkong Government adopted the China Seas Storm Signal Code from 1920, June 1, in place of the Hongkong Non-Local Code introduced in 1917. The signals are displayed on Kowloon Signal Hill.

The following Ports are warned by a telegraphic adaptation of the code:—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Pakhoi, Hoihow, Phulien, Taihoku, Manila, Labuan, and Singapore. 87 storm warnings were sent in 1921 and 122 were received from Manila. 10 were received from Phulien, *via* Quang Chan Wan Radio Station.

Local typhoon signals are exhibited on the Observatory wireless mast and repeated at the Harbour Office, H.M.S. *Tamar*, Green Island, the Godown Company, (Kowloon), Lyemun, and Lai Chi Lok, during the day.

The local night signals are exhibited on the Observatory Wireless Mast and repeated on the tower of the Kowloon Railway Station, on H.M.S. *Tamar*, and at the Harbour Office.

A translation of the non-local and local storm warnings is exhibited at the Harbour Office, the General Post Office and the Star Ferry Piers and also sent to the Cape d'Aguilar Wireless station, which broadcasts the message at about noon and repeats it every two hours until midnight. If a second warning is issued during the day, the later warning is substituted.

When a local storm warning is displayed at the Observatory a cone is exhibited at several outlying stations for the benefit of native craft and passing ocean vessels.

In the following table is given the number of hours the local signals were hoisted in each of the years 1912-1921 :

Year.	Red Signals.	Black Signals.	Bombs. *
	Number of hours hoisted.		Number of times fired.
1912	151	164	...
1913	146	189	1
1914	146	178	...
1915	64	120	...
1916	70	201	1
1917	102	36	...
1918	33	102	1
1919	78	105	1
1920	107	156	...
1921	94	121	...

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signals indicate that a depression exists which may cause a gale at Hongkong within 24 hours. The black signals indicate that a gale is expected at Hongkong.

Prior to July 1917, the red signals indicated that the centre of the typhoon was believed to be more than 300 miles distant, and the black less than 300 miles; the returns for 1912-1916 are therefore not strictly comparable with those for 1917-1921.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS.

TREATY PORTS, &c.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 168 ships operating in the Far East. These logs, representing 5662 days' observations, have been utilised for verifying typhoon tracks. The corresponding figures for the year 1920 were 170 and 5872.

Comparison of Barometers.—The corrections to ships' barometers are usually obtained by comparing their readings while at Hongkong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

* Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

VII.—MAGNETIC OBSERVATIONS.

Magnetic observations were resumed in the new hut in October, the quarters on the site of the old hut having been completed in September.

In the following table the results of observations made with magnetometer Elliott 83 and dip circle Dover 71 in the new hut, for the epoch 1921.9, are compared with the values extrapolated from the observations made with Elliott 55 and Dover 71 in the old hut.

	<i>Observed in new hut with magnet 83 in unifilar 83 and dip circle 71.</i>	<i>Extrapolated from observations in old hut with magnet 55.1 in unifilar 55 and dip circle 71.</i>	
	(a)	(b)	(b)–(a)
	°	°	'
Declination (west)	0°19'8	0°22'6	+2'8
Dip (north)	30°45'8	30°45'0	–0'8
Horizontal Force (C. G. S. unit)	0.37295	0.37190	–0.00105
Vertical Force (C. G. S. unit)	0.22199	0.22125	–0.00074
Total Force (C. G. S. unit)...	0.43402	0.43276	–0.00126

The quantities in the last column should therefore be applied to observations with Elliott 83 and Dover 71 in the new hut, to reduce them to the 1884-1920 series of observations.

VIII.—TIME SERVICE.

Time Ball.—Prior to 1920, January 1, the Time Ball on Kowloon Signal Hill was dropped daily at 1 p.m. (120th Meridian Time). It is now dropped at 10 a.m. and 4 p.m. daily, except on Saturdays when it is dropped at 10 a.m. and 1 p.m., and on Sundays and Holidays when it is dropped at 10 a.m. only.

The Ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

When the Time Ball is out of order the above routine is carried out with flag “z”, on the storm signal mast.

Time Signals are also given at night by means of three white lamps mounted vertically on the Observatory wireless mast. From 8h. 56m. Os. to 9h. 0m. Os. p.m. the lamps are extinguished momentarily at the even seconds, except at the 2nd, 28th, 50th, 52nd, and 54th of each minute. The hours refer to Hongkong Standard Time (8 hours East of Greenwich).

The Ball was dropped successfully 657 times. There were 5 failures attributable to electrical or mechanical defects, and on three occasions the ball was not raised owing to the prevalence of high winds.

The days on which the ball failed to drop were :—April 14, (10*h.*), April 15, (16*h.*), April 16, (10*h.* and 11*h.*) and November 25, (10*h.*).

In the following table is given the number of times different errors occurred in the years 1920 and 1921 :—

Error.	Number of Times.	
	1920	1921
0·3 sec. or less	562	573
0·4 "	61	34
0·5 "	15	11
0·6 "	10	12
0·7 "	...	6
0·8 "	...	4
0·9 "	1	2
1·0 "	1	4
1·1 "	...	2
1·3 "	...	2
1·5 "	1	2
1·6 "	...	2
1·8 "	...	2
2·0 "	...	1

The mean probable error of the time ball in each month for the past five years is given in the following table :—

Month.	Probable Error of the Time Ball.				
	1917	1918	1919	1920	1921
January,	±0·17	±0·11	±0·24	±0·17	±0·25
February,	·10	·13	·20	·30	·13
March,	·11	·15	·12	·21	·44
April,	·18	·10	·19	·15	·27
May,	·17	·12	·14	·17	·16
June,	·10	·14	·14	·13	·17
July,	·21	·11	·13	·22	·10
August,	·11	·26	·15	·11	·10
September,	·10	·16	·10	·24	·20
October,	·10	·12	·15	·15	·10
November,	·10	·12	·14	·19	·10
December,	·10	·14	·12	·13	·11
Means,	±0·13	±0·14	±0·15	±0·18	±0·18

Time Signals by Wireless Telegraphy.—In addition to the time signals given by the Time Ball, and on the wireless mast, signals are sent at 10h. and 21h. by wireless telegraphy *via* Stonecutters. Particulars of the programme are given in the 1918 Report and in Government Notification No. 452 of 12.3.21. The service was transferred from Cape d'Aguilar to Stonecutters on May 1, 1921.

Wireless Receiving Set.—The existing set was dismantled on September 15 and re-wired, with additional apparatus, by the Superintendent of Wireless Telegraphy on December 8. With the new set the Manila time signals on a 5,000 metre are heard distinctly. Also the Funabashi signals. Those from Shanghai are still inaudible, though Mr. Bradshaw hopes to be able to pick them up soon.

Transit Instrument.—Observations for time were made daily with the 3-inch transit instrument and the Hipp tape chronograph by the Chinese computers, weather permitting.

The number of observations in the years 1920 and 1921 were as follows :—

	1920	1921
Transits,	985	1,502
Level determination,	557	869
Azimuth,	20	50
Collimation,	20	37

Transits of the Sun were utilized occasionally during 1921.

A new reticule with darker, more distinct transit lines was received from England on August 5. It was put in place the same day and the transit line intervals determined. The lines were ruled with appreciable asymmetry to prevent any possibility of bias in observing.

The azimuth and collimation determinations were made by the Chief and First Assistants from observations of the old south mark. The error so obtained was checked occasionally by observations of polar stars.

Clocks.—The Standard Sidereal clock, Dent No. 39741, was cleaned and oiled on January 13. From this date its losing rate varied from -1.12 secs. on May 31 (Barometer $29^{\text{ins.}} .58$ Temperature $78^{\circ}.5$) and June 18 (Barometer $29^{\text{ins.}} .42$ Temperature $82^{\circ}.5$) to -0.25 sec. on December 5 (Barometer $30^{\text{ins.}} .15$ Temperature $67^{\circ}.1$).

The rate during cloudy periods was usually derived from the formula :—

$$r = -0.8792 + 0.8575 (b - 29^{\text{ins.}}) + 0.00021 (t - 50^{\circ})$$

where r is the computed losing rate, and b and t the mean barometric pressure and temperature, respectively, for the preceding 24 hours.

In the following table is given the excess of the observed over the computed error after daily periods during 1921 :—

Date 1921.		Interval without observations.	Excess of observed over computed error.
			<i>secs.</i>
February	17,	2 days	— 0'23
March	7,	7 "	+ 0'17
April	1,	12 "	— 1'99
"	30,	4 "	+ 0'52
May	21,	7 "	— 0'22
"	29,	7 "	+ 0'04
June	6,	3 "	+ 0'43
"	21,	4 "	— 0'57
July	4,	4 "	+ 0'10
"	25,	3 "	+ 0'12
August	3,	3 "	— 0'17
September	6,	4 "	+ 0'63
November	21,	4 "	+ 0'03
December	21,	5 "	— 0'32

The Dent Mean Time clock (No. 39740) was used throughout the year for dropping the Time Ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10 a.m. and before 4 p.m. by the electric regulating apparatus. Its daily rate is kept below 0.5 sec. by the addition or removal of weights from the pendulum.

Chronometer Dent No. 40917 is on loan to the Cape d'Aguilar Wireless Station, and chronometer Dent No. 39946 to the Peak Signal Station.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light & Power Co., Ltd., by a rotary converter.

IX.—MISCELLANEOUS.

Seismograph Installation.—One component of the Milne-Shaw Seismograph was received on September 26 and set up on a temporary mounting the next day.

The minute signal sent by the mean time clock for time sealing the records was found to be too short to make a perceptible break in the photographic record, a dash pot was therefore fitted to the eclipsing shutter. Its final form, as constructed by Mr. Evans, is similar in action to the piston in an oil force pump. It allows a sharp forward movement of the shutter, with a slow backward movement. The duration of the eclipse is regulated by

a light spiral spring on the horizontal arm of the dash pot. 5 seconds is found sufficient. A slot is cut in the shutter so as to make only a partial eclipse, thus avoiding loss of register while making a sufficient break to mark the minutes. This idea is due to Mr. J. J. Shaw. The minutes are identified by leading the circuit through contact springs on the face of the barograph clock, the minute hand of which breaks the contact at the 60th minute, as explained on page 1.

The instrument is provided with a fixed mirror for producing a base line; a necessary adjunct for investigating diurnal and secular changes of level.

With its present mounting diurnal tilting of the instrument is very marked, following more closely the external than the internal temperature. This indicates that the movement is due to tilting of the stone pillar on which the instrument is mounted rather than to a temperature effect on the instrument.

37 earthquakes were recorded from September 26 to December 31. Of these 5 were felt as slight shocks locally and 5 others were apparently of local origin, though unfelt.

Meteorological Observations at Victoria Peak.—Meteorological observations at Victoria Peak were commenced in June by Mr. C. H. Cotton, who succeeded Mr. MacGram as Officer in Charge of the Peak Signal Station.

Mr. Cotton seems to have had considerable difficulty in keeping the Anemograph and thermograph in order. The hourly time signals from the Observatory have failed repeatedly and much register has been lost.

Observations made with rotating thermometers at 8h., 10h., noon 14h., and 16h. daily, indicate that in June the temperature of the air at Victoria Peak during the day was 8° F. lower than at the Observatory, Kowloon, and 3° lower in December. The temperature of evaporation was 4° lower in June and 5° higher in November. The relative humidity was 16% higher in June and 42% higher in November.

Atmospherics.—The intensity of atmospherics was recorded by the operators at Stonecutters Naval Radio-Station 13 times daily, throughout the year, on a scale of 0 to 4, and curves have been prepared showing the annual inequality and the mean diurnal inequality in each month.

The maximum intensity, 2.92, occurred in May, with a secondary maximum, 2.35, at the end of August, and the minimum, 1.50, in December.

As regards diurnal inequality the maximum intensities occurred at midnight in the spring and autumn, at 3 a.m. in the summer, and at 2 a.m. in the winter. The minimum intensity occurred at 10 a.m. in the spring and winter and at 9 a.m. in the summer and autumn.

The times are approximate and refer to Hongkong Standard Time (8 hours East of Greenwich).

Arrangements have been made for the hourly observation at the Cape d'Aguilar Radio Station of the intensity and type of atmospherics also the wave on which they reach a maximum. It is hoped that these observations will be of service to the Radio Research Board, and will determine whether systematic observation of atmospherics can be utilised for weather forecasting.

Upper Air Research.—2 theodolites, slide rules, hydrogen and pilot balloons for upper air research were received in May, and 19 ascents made between June 10 and September 21. The longest flight was 70 minutes on July 11. The results of the observations have been communicated to the International Commission for the investigation of the upper air.

The military Authorities have been approached with a view to obtaining the assistance of two N.C.O.s from the Corps of Royal Engineers, in order that the balloons may be observed simultaneously with two theodolites, one at the Observatory and one on the Signal Hill, Kowloon. Observation with only one theodolite necessitates the assumption that the rate of ascent can be computed from the weight and free lift of the balloon, and that it remains constant; whereas simultaneous observations with two theodolites, one at each end of a base line, furnish data for the computation of the height of the balloon at each observation.

It was thought advisable to ascertain how far the assumptions necessitated by the one theodolite method are justified in Hongkong before continuing the ascents. The rate of ascent is of course affected by vertical currents, and accumulation of data by the two theodolite method may show that in certain types of weather the single theodolite method will suffice and that in certain other types the single theodolite method should not be used.

Up to the present only two balloons have been found defective. This is gratifying as it was feared they might suffer from the voyage and climate.

The Winds of Hongkong.—A memoir on the winds of Hongkong was completed during the year and will be published shortly.

Visit to Other Observatories.—In the Spring the Director visited the Observatories at Shanghai, Kobe, Tokio and Manila to discuss with the directors the following questions:—

- (1.) The substitution of Hankow observations for those at Gutzlaff in the Shanghai daily weather telegrams, and of a more westerly station than Nemuro in the list of Japanese reporting stations. Also the possibility of sending the Ilochoos observations *via* Formosa instead of *via* Tokio.

- (2.) The possibility of uniform hygrometric methods and uniform units for weather maps and other publications.
- (3.) Adoption by the Japanese Authorities of the Hongkong telegraphic code for daily weather telegrams. This code is used by all the other Weather Bureaus in the Far East.
- (4.) A uniform system of wireless time-signals.

The proposals were sympathetically received, but there are difficulties in adopting them which have not yet been overcome.

Staff.—No change occurred in the European Staff. Mr. B.D. Evans, First Assistant, acted as Chief Assistant during the absence on leave of Mr. C.W. Jeffries from June 19 to the end of the year.

Yuen Lai Sang, Vth grade telegraphist, was promoted to Vth grade in the General Post Office on December, 31.

Ip Chun Woo, probationer telegraphist, was dismissed on April 2 and was replaced by Ng Hung Kui, who resigned on August 31. His successor, Lan Sing Tong, resigned on December 31.

Government has been asked to make the scale of pay for these telegraphist-observers sufficient to attract and retain good men.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows :—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1912	22,595.08	.....	757.94
1913	24,255.49	1,660.41	.....
1914	25,398.31	1,142.82	.....
1915	23,233.12	.....	2,165.19
1916	21,977.78	.....	1,255.34
1917	26,890.50	4,912.72	.....
1918	20,028.24	.....	6,862.26
1919	23,450.57	3,422.33	.....
1920	25,965.66*	2,515.09	.....
1921	32,700.51†	6,734.85	.....

* Increases to European Staff.

† Increases to Local Staff, seismograph, and instruments for upper air research.

Acknowledgements.—Acknowledgements are here made to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs authorities, for daily observations and extra observations during typhoon weather, to the Telegraph Companies for transmitting the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by wireless telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for carrying on the routine work of the Observatory with a shortage of trained telegraphist-observers.

T. F. CLAXTON,
Director.

1922, February 20.

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REPORT OF THE DIRECTOR OF THE ROYAL OBSERVATORY, HONGKONG, FOR THE YEAR 1922.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

Excavations for an underground room for the seismograph and clocks were commenced in September.

Gas fires in all rooms, and 2 geysers, were installed in November.

II.—METEOROLOGICAL INSTRUMENTS.

Barometers.—The Marvin compensated syphon barograph, which was set up in February, has worked well during the year, except that some mercury leaked at the ground joints.

The action of the barograph has been improved by the introduction of a buzzer, operated every minute for 0.7 second by a signal from the mean time clock.

The station barometer No. 1323 and the large Casella barometer are compared with the Observatory Standard usually once a month.

Beckley Anemograph.—This instrument was oiled and the orientation of the vane checked once a month.

Dines-Barendell Anemograph.—The bearings of the vane were oiled and its orientation checked once a month. The spindle of the float was cleaned and oiled once a week. On March 26 a hole was drilled in the standard to permit of oiling the spindle above the mercury cup. The hole is closed by a screw to prevent the ingress of water or dust. The instrument requires frequent calibration. Its action at low velocities is uncertain.

The mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1921 are given in the following table, together with the results for 1922 :—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor ($\text{Dines} \div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1921.	1922.
January,	2'01	2'10
February,	2'05	2'22
March,	2'07	2'24
April,	2'09	2'42
May,	2'13	3'21
June,	2'17	1'32
July,	2'24	1'68
August,	2'20	1'24
September,	2'19	1'55
October,	2'12	1'44
November,	2'05	1'10
December,	2'01	1'16
Year,	2'11	1'81

Gap Rock Anemograph.—A leak developed in the float in the month of June. After several attempts to repair it the instrument was again brought to the Observatory. The alterations to the vane mentioned last year had the desired effect in increasing its sensibility, but with N and E winds, which are variable and gusty, it occasionally made a complete revolution and so carried the pen off the paper.

Thermometers.—All thermometers in use were compared with the Kew Standard in winter and summer.

Richard Thermograph.—This instrument worked satisfactorily during the year, though the base lines as laid down from the hourly eye observations of rotating thermometers still show irregularities, except on dull days with small range of temperature. This is due partly to thermograph lag.

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura pluviograph, the amount of sunshine by two Campbell-Stokes universal sunshine recorders, and the relative humidity of the air by a small Richard hair hygograph. Eye observations of

barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hongkong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal features of the Weather.—The principal features of the weather in 1922 were:—

- (a) Typhoon gales on July 12-13, July 27-29, August 3 and September 20-21.
- (b) Low barometric pressure in February, August and September.
- (c) Rainfall in serious defect from May 23 to July 6, and from September 23 to December 17. Heavy and well distributed rains from July 27 to September 4.
- (d) Low wind velocity in April and November.

Barometric pressure was considerably below normal in February, August and September. The mean pressure for the year at station level was $29\cdot820^{\text{ins.}}$ as against $29\cdot848^{\text{ins.}}$ in 1921 and $29\cdot843^{\text{ins.}}$ for the past 39 years. The highest pressure was $30\cdot445^{\text{ins.}}$ on November 26 as against $30\cdot323^{\text{ins.}}$ in 1921 and $30\cdot509^{\text{ins.}}$ for the past 39 years. The lowest pressure was $29\cdot174^{\text{ins.}}$ on August 3 as against $29\cdot319^{\text{ins.}}$ in 1921 and $28\cdot735^{\text{ins.}}$ for the past 39 years.

The temperature of the air was above normal from January to August, considerably in February and May and slightly in the other months. From September to the end of the year it was slightly below normal. The mean temperature for the year was $72^{\circ}\cdot4$ as against $72^{\circ}\cdot2$ in 1921 and $71^{\circ}\cdot8$ for the past 39 years. The highest temperature was $93^{\circ}\cdot1$ on August 2, as against $92^{\circ}\cdot2$ in 1921 and $97^{\circ}\cdot0$ for the past 30 years. The lowest temperature was $43^{\circ}\cdot7$ on November 26 as against $44^{\circ}\cdot0$ in 1921 and $32^{\circ}\cdot0$ for the past 39 years.

The rainfall was considerably above normal in February and August. It was considerably below normal from the middle of May to the beginning of July and from the end of September to the middle of December. The total for the year was $69\cdot43^{\text{ins.}}$ as against $97\cdot34^{\text{ins.}}$ in 1921, and $84\cdot23^{\text{ins.}}$ for the past 39 years. The greatest fall in one civil day was $3\cdot70^{\text{ins.}}$ on September 21 and the greatest in one hour was $1\cdot62^{\text{ins.}}$ between 7.30 p.m. and 8.30 p.m. on August 28.

The wind velocity was considerably below normal in April and November, and moderately below in June, August, September and October. It was slightly above in January, February and July. The mean velocity for the year was $11\cdot6$ m.p.h. as against $10\cdot7$ m.p.h. in 1921, and $12\cdot6$ m.p.h. for the past 39 years. The

maximum velocity for one hour, as recorded by the Beckley Anemograph, was 55 miles at 9 p.m. on September 20 as against 51 miles in 1921 and 108 miles for the past 39 years. The maximum squall velocity, as recorded by the Dines-Baxendell Anemograph, was at the rate of 75 m.p.h. at 11h. 5m. p.m. on September 20 as against 69 m.p.h. in 1921 and 105 m.p.h. for the past 13 years.

Rainfall at Four Stations.—In the following table the monthly rainfall for the year 1922 at the Observatory is compared with the fall at the Police Station, Tai Po; the Botanical Gardens; and the Matilda Hospital, Mount Kellet :—

Months.	Observatory (<i>Kowloon</i>).	Police Station (<i>Tai-po</i>).	Botanical Gardens (<i>Hongkong</i>).	Matilda Hospital (<i>Hongkong</i>).
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	2.66c	2.99	1.95	2.13
February, ...	5.490	7.68	5.49	4.72
March,	3.675	7.03	4.80	2.59
April,	2.020	2.17	2.34	2.22
May,	5.495	8.64	5.87	4.71
June,	6.525	16.46	7.20	6.49
July,	12.800	17.03	18.33	14.02
August,	17.535	19.50	20.15	15.83
September,...	9.935	9.88	8.51	6.56
October,	2.025	1.37	2.92	2.53
November, ...	0.535	0.38	0.64	0.75
December, ...	0.740	0.80	1.01	0.88
Year,...	69.435	93.93	79.21	63.43

Floods.—The heaviest rainfall occurred at the Observatory as follows :—

<i>Period.</i>				<i>Amount.</i> inches.	<i>Duration.</i> hours.	<i>Greatest fall</i> <i>in 1 hour.</i>	
						<i>Amount.</i> inches.	<i>Time.</i> d. h.
June...20	5 to	June 21	22	4.81	19	1.30	June 21 3
July.... 8	20 to	July 14	17	8.18	48	1.18	July 10 11
Aug....26	5 to	Sept. 4	19	10.88	72	1.62	Aug. 28 20
Sept....20	14 to	Sept. 22	14	5.65	40	0.80	Sept. 21 2

Typhoons.—The tracks of 20 typhoons and 11 of the principal depressions which occurred in the Far East in 1922 are given in two plates in the Monthly Meteorological Bulletin for December, 1922.

IV.--PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East for 6 a.m. of the 120th meridian, and the Daily Weather Report (containing meteorological observations, usually at 6^h. and 14^h., from about 40 stations in China, Indo-China, Japan, the Philippines and Borneo) and daily weather forecasts for Hongkong to Gap Rock, the Formosa Channel, the south coast of China between Hongkong and Lamocks, and between Hongkong and Hainan, were issued as in former years. Copies of the map were exhibited on notice boards at the Hongkong Ferry Pier, Blake Pier, and the Harbour Office. One copy was sent daily to the Institute of Engineers and Shipbuilders and one to the Director of the Meteorological Observatory, Macao. Forty copies of the Daily Weather Report were distributed to various offices, etc., in the Colony, and a copy was sent daily to the Director of the Meteorological Observatory, Macao. Copies were sent every week to the Hydrographic Office, Bangkok.

A charge of \$10 a year is made for supplying private firms and individuals with the Daily Weather Report, and \$36 for the Weather Map. No maps were published on January 1, February 12, March 4, July 7, 8, 9, August 3, 4, and 6, owing to the late arrival of weather telegrams. On several other occasions the map, though published, contained but meagre information.

The weather forecast is telegraphed daily to the Cape d'Aguilar Wireless Station in time for distribution at 1 p.m. It is broadcast again at 5 p.m.

Monthly Meteorological Bulletin.—The monthly Meteorological Bulletin, which includes the Daily Weather Report, was published as usual, and distributed to the principal observatories and scientific institutions in different parts of the world.

Monthly Seismological Bulletin.—The publication of a monthly seismological bulletin, giving particulars of earthquakes recorded by the Milne-Shaw seismograph, was continued throughout the year, and distributed to the principal seismological Observatories.

Miscellaneous Returns.—A monthly abstract of observations made at the Observatory is published in the Government Gazette, and monthly and yearly results are published in the Blue Book in the form suggested by the London Meteorological Office for the British Colonies. The monthly departures from normal of the barometric pressure at four China Coast Ports are communicated to the Commonwealth Meteorologist, Melbourne, in connection with long range weather forecasts. Monthly meteorological returns are forwarded to the Meteorological Magazine, and annual returns to the Stock Exchange Official Intelligence, the Colonial Office List, and Whitaker's Almanack.

V.—WEATHER TELEGRAMS, FORECASTS, AND STORM WARNINGS.

Daily Weather Telegrams.—The improvement in this service continues, but occasionally the observations from Japan and Indo-

China still arrive too late for insertion in the Daily Weather Map. Occasionally belated weather telegrams are received from South China, but as a rule the observations from these districts are posted in batches to Hongkong, as are those from Central China.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rate during typhoons, on receipt of certain code words from Hongkong:—Amoy, Canton, Macao, Phulien, Sharp Peak, and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The extra 9 p.m. telegram from Swatow, kindly sanctioned by the Chinese Telegraph Administration during the typhoon season, was seldom received.

Weather Telegrams by Radio.—The following table gives the monthly number of ships, of different nationalities, from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately).

Month.	British (in- cluding H.M. Ships).		Dutch.		Japan- ese.		Other National- ities.		Total	
	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.
January,	16	40	6	9	1	1	1	2	24	52
February,	14	40	4	6	2	5	...	...	20	51
March,	15	38	10	15	7	11	4	5	36	69
April,	13	31	8	10	1	4	1	2	23	47
May,	30	75	12	22	8	15	4	5	54	117
June,	31	78	15	28	8	18	10	20	64	144
July,	37	114	11	24	13	20	8	15	69	173
August,	27	56	16	35	19	29	7	10	69	130
September,	31	98	15	32	22	47	11	17	79	194
October,	29	61	15	25	29	58	5	10	78	154
November,	18	54	15	29	32	53	7	19	72	155
December,	19	47	13	28	22	44	7	29	61	148
Totals 1922,	280	...	140	...	164	...	65	...	649	...
Totals 1921,	121	...	84	...	40	...	21	...	266	...
Totals 1920,	64	...	48	...	25	...	3	...	140	...
Totals 1919,	17	...	36	...	6	...	2	...	61	...

It will be seen that the number of messages received has increased, averaging 1·8 ships per day in 1922. This represents only 12% of the average number of ships within call of Cape d'Aguilar, however. It is to be hoped that the time is not far distant when every ship within call will send observations by radio telegraphy as a matter of routine, in accordance with the Notice to Mariners on the subject.

Results of Weather Forecasts.—The results of the comparison of the daily weather forecasts with the weather subsequently experienced are given below, with the results of the previous five years :—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1917	67	29	4	○
1918	71	26	3	○
1919	71	27	2	○
1920	64	30	5	1
1921	65	30	5	○
1922	67	30	3	○

No forecasts were issued on January 1, February 12, March 4, July 7, 8, 9 and August 6, owing to lack of telegraphic information.

The forecast comprises wind direction, wind force, and weather.

Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings.—At the request of the Chamber of Commerce the Hongkong Government adopted the China Seas Storm Signal Code from 1920, June 1, in place of the Hongkong Non-Local Code introduced in 1917. The signals are displayed on Kowloon Signal Hill.

The following Ports are warned by a telegraphic adaptation of the code :—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phulien, Taihoku, Manila, Labuan, and Singapore. 124 storm warnings were sent in 1922 and 141 were received from Manila. 26 were received from Phulien, *via* Quang Chau Wan Radio Station.

The storm warning service to Pakhoi and Hoilhow has been discontinued, as the warnings never arrive in time to be of any use.

Local typhoon signals are exhibited on the Observatory radio mast and repeated at the Harbour Office, H.M.S. *Tamar*, Green Island, the Godown Company, (Kowloon), Lyemun, and Lai Chi Kok, during the day.

The local night signals are exhibited on the Observatory Radio Mast and repeated on the tower of the Kowloon Railway Station, on H.M.S. *Tamar*, and at the Harbour Office.

A translation of the non-local and local storm warnings is exhibited at the Harbour Office, the General Post Office and the Star Ferry Piers and also sent to the Cape d'Aguilar Radio station, whence it is broadcast at about noon and repeated every two hours until midnight. If a second warning is issued during the day, the later warning is substituted.

When a local storm warning is displayed at the Observatory a cone is exhibited at several outlying stations for the benefit of native craft and passing ocean vessels.

In the following table is given the number of hours the local signals were hoisted in each of the years 1918-1922.

Year.	Red Signals.	Black Signals.	Bombs. *
	Number of hours hoisted.		Number of times fired.
1918	33	102	1
1919	78	105	1
1920	107	156	...
1921	94	121	...
1922	181	154	...

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signals indicate that a depression exists which may possibly cause a gale at Hongkong within 24 hours. The black signals indicate that a gale is expected at Hongkong.

* Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &c.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 172 ships operating in the Far East. These logs, representing 5,763 days' observations, have been utilised for verifying typhoon tracks. The corresponding figures for the year 1921 were 168 and 5662.

Comparison of Barometers.—The corrections to ships' barometers are usually obtained by comparing their readings while at Hongkong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

VII.—MAGNETIC OBSERVATIONS.

Horizontal force, declination, and dip are observed once a month. In the dip observations 4 needles are used in rotation, the result for each month being the mean of determinations with two needles.

In the following table are given the annual values of the magnetic elements in 1922, as derived from observations made in the new magnetic hut with magnetometer Elliott 83 and dip circle Dover 71:—

	1922. ° /
Declination (west)	0°21'5
Dip (north)	30°46'0
Horizontal Force (C. G. S. unit).....	0·37279
Vertical Force (C. G. S. unit).....	0·22194
Total Force (C. G. S. unit).....	0·43386

During the eclipse of the Sun on September 21, observations of magnetic declination were made every minute by Colonel and Mrs. Roberts, Messrs. Claxton, Jeffries, Evans, Badan Singh and Yuen Lai Sang. The observations were forwarded to Dr. Bauer, Director of the Department of Terrestrial Magnetism of the Carnegie Institute, who is collecting information from all parts of the world for determining the effect of the eclipse on the earth's magnetism.

VIII.—TIME BALL.

Time Ball.—Prior to 1920, January 1, the Time Ball on Kowloon Signal Hill was dropped daily at 1 p.m. (120th Meridian Time). It is now dropped at 10 a.m. and 4 p.m. and daily, except on Saturdays when it is dropped at 10 a.m. and 1 p.m., and on Sundays and Holidays when it is dropped at 10 a.m. only.

The Ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

When the Time Ball is out of order the above routine is carried out with flag "z", on the storm signal mast.

Time Signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. From 8h. 56m. 0s. to 9h. 0m. 0s. p.m. the lamps are extinguished momentarily at the even seconds, except at the 2nd, 28th, 50th, 52nd, and 54th of each minute. The hours refer to Hongkong Standard Time (8 hours East of Greenwich).

The Time Ball was dropped successfully 653 times. There were 4 failures attributable to electrical defects, or negligence on the part of the computer on duty in the tower, who was dismissed. On 4 occasions the ball was not raised owing to the prevalence of high winds. The days on which the ball failed were April 1st and 25th, September 4th and 30th. These failures occurred at 10 a.m. and in each case the fault was remedied and the ball dropped at 11 a.m.

In the following table is given the number of times different errors occurred in the years 1921 and 1922:—

Error.	Number of Times.	
	1921	1922
0·3 sec. or less	573	633
0·4 "	34	10
0·5 "	11	6
0·6 "	12	2
0·7 "	6	...
0·8 "	4	1
0·9 "	2	1
1·0 "	4	...
1·1 "	2	...
1·3 "	2	...
1·5 "	2	...
1·6 "	2	...
1·8 "	2	...
2·0 "	1	...

The mean probable error of the time ball in each month for the past five years is given in the following table:—

Month.	Probable Error of the Time Ball.				
	1918	1919	1920	1921	1922
January,	±0'11	±0'24	±0'17	±0'25	±0'10
February,	'13	'20	'30	'13	'15
March,	'15	'12	'21	'44	'12
April,	'10	'19	'15	'27	'20
May,	'12	'14	'17	'16	'10
June,	'14	'14	'13	'17	'11
July,	'11	'13	'22	'10	'14
August,	'26	'15	'11	'10	'10
September,	'16	'10	'24	'20	'15
October,	'12	'15	'15	'10	'10
November,	'12	'14	'19	'10	'17
December,	'14	'12	'13	'11	'10
Means,	±0'14	±0'15	±0'18	±0'18	±0'13

Time Signals by Radio Telegraphy.—In addition to the time signals given by the Time Ball, and on the radio mast, signals are sent at 10*h.* and 21*h.* by radio telegraphy *via* Stonecutters. Particulars of the programme are given in the 1918 Report and in Government Notification No. 452 of 12.3.21. The service was transferred from Cape d'Aguilar to Stonecutters on May 1, 1921.

Radio Receiving Set.—The radio receiving set was in irregular use throughout the year. 109 comparisons were obtained with the Manila Observatory clock *via* Cavite, and 27 with the Tokio Observatory clock, *via* Funabashi.

The mean of the comparisons makes Tokio 0'54 sec. fast and Manila 1'03 secs. fast on Hongkong.

Between July 28th and August 26th Manila was not heard although listened for daily. This may have been due to defects in the receiving apparatus, the adjustments of which are extremely critical. From November 29th to December 26th no signals were heard, in spite of repeated attempts to adjust the apparatus. It was thoroughly overhauled and re-wired on December 22nd and 23rd since when it has worked satisfactorily.

The Sicawei time signals (*via* Koukaza) were not heard, although listened for on many occasions.

Transit Instrument.—Observations for time were made daily with the 3-inch transit instrument and the Hipp tape chronograph by the Chinese computers, weather permitting.

The number of observations in the years 1921 and 1922 were as follows:—

	1921	1922
Transits	1,502	1,307
Level determination	869	696
Azimuth	50	31
Collimation	37	28

Transits of the Sun were utilized occasionally.

The azimuth and collimation determinations were made by the Chief and First Assistants from observations of the old south mark. The error so obtained was checked occasionally by observations of polar stars.

Clocks.—The performance of the Standard Sidereal clock conformed to no previous experience, and emphasises the necessity for a clock of more modern type, the rate of which may be depended upon during cloudy periods. During the past year cloudy periods (*i.e.* periods without transit observations) have, fortunately, not been prolonged.

In the following table is given the excess of the observed over the computed error after cloudy periods during 1922:—

Date 1922.		Interval without observations.	Excess of observed over computed error.
			<i>secs.</i>
January	4	2 days	— 0'09
"	13	2 "	+ 0'14
"	22	4 "	+ 0'14
February	2	8 "	— 0'40
"	15	4 "	+ 0'47
"	24	7 "	+ 0'06
March	9	12 "	+ 0'52
"	19	2 "	— 0'09
"	27	6 "	— 0'02
April	3	2 "	+ 0'45
"	7	3 "	+ 0'35
"	21	2 "	+ 0'32
"	27	3 "	— 0'12
May	16	4 "	+ 0'12
"	31	6 "	+ 0'11
June	7	2 "	+ 0'14
"	21	7 "	— 0'04
July	14	4 "	+ 0'50
"	30	3 "	+ 0'32
August	5	3 "	0'00
"	25	4 "	— 0'15
September	6	11 "	— 0'46
"	23	4 "	+ 0'12
October	5	3 "	+ 0'10
"	25	7 "	+ 0'06
November	7	2 "	+ 0'14
"	26	4 "	— 0'15
December	6	3 "	— 0'25
"	21	6 "	+ 0'03

The Dent Mean Time clock (No. 39740) was used throughout the year for dropping the Time Ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10 a.m. and before 4 p.m. by the electric regulating apparatus. Its daily rate is kept below 0.5 sec. by the addition or removal of weights from the pendulum.

Chronometer Dent No. 40917 is on loan to the Cape d'Aguilar Radio Station, Dent No. 39946 was returned from the Peak Signal Station on December 9.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light & Power Co., Ltd. by a rotary converter.

IX.—MISCELLANEOUS.

Seismograph.—The east-west component of the Milne-Shaw seismograph has worked satisfactorily during the year, though there occur occasional dislocations of the register for which no reason can be assigned: also tremor storms and irregular movements, both large and small. The pendulum for recording N. S. movements was received in December.

Experiments made on April 20, 21, and 27 indicated that the temperature co-efficient of the seismograph, as regards tilt, is negligible.

144 earthquakes were recorded during the year. The seismograms have been forwarded to the President of the Seismological Committee, Oxford.

An underground room is being built for the reception of both pendulums and the standard clock.

Meteorological Observations at Victoria Peak.—These were so unsatisfactory that they were discontinued in December by order of His Excellency the Governor.

Atmospherics.—The intensity of atmospherics was recorded by the operators at Stonecutters Radio Station, on a scale of 0 to 4, 13 times daily, 8 times on a long wave and 5 times on a short wave.

From March 12 to the end of the year the intensity and character of atmospherics were also observed by the operators at Cape d'Aguilar Radio Station hourly, on a scale of 0 to 6, the wave length being 600 metres. The maximum hourly intensity occurred at about mid-night in the summer and winter, and at

about 3 a.m. in the spring and autumn. The minimum intensity occurred at about 9 or 10 a.m. The maximum monthly intensity, 4.29, occurred in May with a shallow secondary maximum, 2.91, in August, and the minimum intensity, 1.71 in November.

The times are approximate and refer to Hongkong Standard Time (8 hours East of Greenwich).

Upper Air Research.—40 flights with pilot balloons were made during the year. The results of the observations have been sent to the *Commission Internationale pour l'exploration de la haute atmosphere*, Kristiania.

The Military Authorities very kindly placed at my disposal the services of two N.C.O.'s of the Corps of Royal Engineers to assist in this work, and two double theodolite ascents were made, the secondary station being the top of the time-ball tower. As the distance from the Observatory is only 2,055 feet, however, the results were not satisfactory above about 5,000 feet.

It is hoped that a more suitable secondary station may be found.

Up to the time of writing last year's report only two balloons had been found defective. During the past year however many such have been found. In future small monthly shipments will be ordered.

Wind Tables.—Tables for deriving the resultant direction and velocity of the wind from the north and east components were completed in the spring. They give direction from 0° to 360° to single degrees, and velocity, to tenths of a mile, for north and east components from +33 to -33 miles, by tenths of a mile from +3 to -3 miles and by single miles for the remainder. The object of the tables is to obtain the correct quadrant for the direction without mental effort on the part of the computer.

Effect of fan on wet bulb thermograph.—In the following table are given the revised corrections to the readings of an unspirated wet bulb thermometer in an "Indian" shelter to reduce them to those of a whirled thermometer, at different wind velocities, and for different depressions of the wet bulb. The results are based on about 1,500 measures of the effect of an electric fan playing on to the wet bulb thermometer of the thermograph for the last 5 minutes of each hour. Only those hours have been used in which the register is sufficiently smooth to enable the effect of the fan to be measured with certainty.

The corrections are slightly larger than those given in the 1918 Report, indicating that aspiration for one minute is not sufficient. The wind velocity in the table is that recorded by the Beckley anemograph using the old factor 3. The cups of the anemograph are 45 feet above the ground.

Revised corrections to the readings of an unspirated wet bulb thermometer in an Indian shelter to reduce them to those of a whirled thermometer, at different wind velocities, and for different depressions of the wet bulb.

Wind Velocity	t - t ¹ (Fahrenheit)															
	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°
m.p.h.																
0	—	.1	.4	.5	.6	.8	.9	—	—	—	—	—	—	—	—	—
1	.1	.2	.3	.4	.6	.7	.8	1.0	—	—	—	—	—	—	—	—
2	.0	.2	.3	.4	.5	.7	.8	1.0	1.1	1.3	1.5	1.7	1.8	2.1	2.4	2.6
3	.0	.1	.2	.4	.5	.6	.8	1.0	1.1	1.3	1.5	1.7	1.8	2.1	2.3	2.6
4	.0	.1	.2	.4	.5	.6	.8	.9	1.0	1.2	1.3	1.7	—	—	—	—
5	.0	.0	.1	.3	.4	.6	.8	.9	1.0	1.1	1.2	—	—	—	—	—
6	...	.0	.0	.2	.3	.5	.8	.9	1.0	1.1	1.2	—	—	—	—	—
7	...	...	.0	.1	.2	.5	.7	.9	1.0	1.0	1.1	—	—	—	—	—
8	...	...	...	.0	.2	.4	.6	.8	.9	1.0	1.0	—	—	—	—	—
9	...	...	...	.0	.1	.3	.5	.7	.8	.9	—	—	—	—	—	—
10	...	...	...	.0	.1	.3	.5	.6	.7	.8	—	—	—	—	—	—
11	...	...	...	.0	.1	.3	.5	.5	.6	.7	—	—	—	—	—	—
12	...	...	...	.0	.1	.2	.4	.5	.6	.6	—	—	—	—	—	—
13	...	...	...	.0	.1	.2	.3	.4	.5	.6	—	—	—	—	—	—
14	...	...	...	.0	.1	.1	.2	.3	.4	—	—	—	—	—	—	—
15	...	...	...	.0	.1	.1	.2	.3	.4	—	—	—	—	—	—	—
16	...	...	...	.0	.1	.1	.2	.2	.4	—	—	—	—	—	—	—
17	...	...	...	.0	.1	.1	.1	.2	.4	—	—	—	—	—	—	—
18	...	...	...	...	.0	.1	.1	...	...	—	—	—	—	—	—	—
19	...	...	...	...	.0	.1	.1	...	...	—	—	—	—	—	—	—
20	...	...	...	...	...	.0	.0	...	...	—	—	—	—	—	—	—

Visitors.—Rear Admiral Learmouth, the Hydrographer, visited the Observatory on January 13. Lieut. A. L. B. Carmona, Harbour Master at Macao, came to obtain information concerning the Milne-Shaw Seismograph on September 25, and Professor K. Tamgachi to obtain information concerning the Climate of Hong-kong, on October 11. Sir Keith Smith visited the Observatory on October 10-12 in connection with a projected round the world flight. Professor Kiyogusa Sotome, of the Tokio Observatory, visited the Observatory on November 8, and the Rev. Father Algué S.J., director of the Philippine Weather Bureau, on December 21-22.

50 members of the Chinese Y.M.C.A. were shown over the Observatory on March 18. A class of 35 boys of the Diocesan School on March 28, and another class on March 29. 30 students of the Union Middle School, Canton, were shown over on October 30 and 15 students from St. Stephen's College, Hongkong, on December 7.

Staff.—No change occurred in the European staff. Mr. B. D. Evans, First Assistant, continued to act as Chief Assistant until the return of Mr. C. W. Jeffries on April 14.

The following re-grading of the local staff was approved on January 26 :—

2	3rd	Grade	telegraphist-computers
2	4th	„	„
2	5th	„	„

Probationers to receive \$60 a month until fit for promotion to 5th grade telegraphist-computers.

The new grading is to be adopted as opportunity offers.

Chu Ip Sheung was appointed probationer telegraphist on January 24. Yuen Lai Sang, who was transferred to the Post Office Department on 1921, December 31, was re-transferred to the Observatory as 4th grade telegraphist-computer on May 1, to replace Wan Sik Wing who had been on 3 months probation but had been found unsuitable.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows :—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1913	24,255.49	1,660.41	.....
1914	25,398.31	1,142.82	.....
1915	23,233.12	.....	2,165.19
1916	21,977.78	.....	1,255.34
1917	26,890.50	4,192.72	.....
1918	20,028.24	.....	6,862.26
1919	23,450.57	3,422.33	.....
1920	25,965.66	2,515.09	.....
1921	32,700.51	6,734.85	.....
1922	38,350.10	5,649.59	.....

Acknowledgements.—Acknowledgements are here made to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs authorities, for daily observations and extra observations during typhoon weather, to the Telegraph Companies for transmitting the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties.

T. F. CLAXTON,
Director.

1923, February 9.

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REPORT OF THE DIRECTOR OF THE ROYAL
OBSERVATORY, HONGKONG, FOR THE YEAR 1923.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

In October two rows of iron shelves were fixed round the wall of the Old Time-Ball Tower to take the overflow of records from the Observatory.

The underground room for the seismograph and clocks was completed in the month of May. It consists of a double room with an air space of 2 feet between the inner and outer walls and roofs. The floor is 17 feet below the level of the ground. The inner room is 20 feet square and 10 feet 9 inches high at centre, with 9 inch brick walls.

The outer walls are of concrete, 2 feet 6 inches thick at the base tapering to 12 inches thick at the top.

Both roofs are of ferro-concrete. The outer roof is 4 feet below the level of the ground and is covered with disintegrated granite, which is turfed to the level of the surrounding lawn.

In the middle of the room is the seismograph pillar, a block of concrete 6 feet by 4 feet rising from a depth of 10 feet below the floor. The latter consists of 6 inches of lime and red earth concrete covered with 4 inches of cement concrete. It is not in contact with the pillar. The corners of the inner walls are bricked in so as to make the horizontal section an isosceles right-angled triangle, of which the hypotenuse is 4 feet. These will serve as pillars for the clocks.

A system of subsoil drainage is provided and ventilation is assisted by a 9 inch extract pipe, running to the roof of the Observatory, which connects with the air space between the inner and outer roofs. 18 inch cast iron grids are also provided at ceiling and floor levels to give air communication between the chamber and enclosing air space.

Steps leading from the verandah in front of the old Clock Room give access to the inner room through two pairs of swing doors four feet apart.

The room was very damp at first, the mean relative humidity in May being 96%. At the end of June five radiators were installed temporarily, and with the current on for 48 hours the relative humidity was reduced from 96% to 75%. On removing the

radiators, however, it increased again to 94% in 3 days, and remained between 90% and 97% until September 10, when the relative humidity of the outside air fell to 47%. In response the relative humidity in the basement fell to 75% on the 12th.

After fluctuating between 91% and 76% it fell to 58% on September 29 owing to another dry spell. The mean was 79% in November and 73% in December, occasionally increasing to 85% however.

The diurnal variation of temperature is negligible, as shown by the following table:—

Mean Temperature in Underground Chamber at 4 hourly intervals.

Month 1923.	Hour (H.K. Standard Time).					
	0	4	8	12	16	20
	o	o	o	o	o	o
November,	75.28	75.23	75.24	75.25	75.27	75.23
December,	72.72	72.64	72.63	72.66	72.68	72.68

The annual variation is given below.

Mean Temperature in Underground Chamber from May to December 1923, compared with the temperature of the outside air.

Month.	Mean Monthly Temperature.	
	of Basement.	of Outside Air.
	o	o
May,	73.2	77.8
June,	76.6	80.6
July,	79.7	82.0
August,	79.5	81.2
September,	79.3	81.1
October,	77.1	76.0
November,	75.3	71.6
December,	72.7	64.3

II.—METEOROLOGICAL INSTRUMENTS.

Barometers.—The Marvin compensated syphon barometer has required frequent attention. In the month of June a stiff wire 6 inches long was screwed into the armature of the buzzer and adjusted so as to vibrate the vertical wire on which the pen carrier slides. This has accentuated the action of the buzzer and kept the

recording parts in correct tension. At the same time the hourly time-break was made to work directly from the hourly signal current, as the original arrangement by which the hand of the barograph clock diverted the minute signal from the seismograph to the barograph, every 60th minute, was occasionally uncertain in its action.

The station barometer No. 1323 and the large Casella barometer were compared with the Observatory Standard on April 30.

Beckley Anemograph.—This instrument was oiled and the orientation of the vane checked once a month.

During the typhoon of August 18, the cups were caught in the antennæ of the wireless aerial, which were broken by the strong wind. They were repaired on August 23.

Dines—Baxendell Anemograph.—The bearings of the vane were oiled and its orientation checked once a month. The spindle of the float was cleaned and oiled once a week.

The Mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1922 are given in the following table, together with the results for 1923 :—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor ($\text{Dines} \div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1922.	1923.
January,	2'01	1'31
February,	2'06	1'40
March,	2'09	1'58
April,	2'11	1'58
May,	2'21	1'52
June,	2'10	1'69
July,	2'20	1'95
August,	2'21	1'95
September,	2'14	1'86
October,	2'07	1'86
November,	1'97	1'80
December,	1'95	1'50
Year,	2'09	1'67

Gap Rock Anemograph.—As the exposure of this instrument was found to be unsatisfactory, it was not returned to Gap Rock. It is proposed to mount it at Waglan early in 1924.

Thermometers.—All thermometers in use were compared with Kew Standard No. 647 in winter and summer.

A new Standard was obtained from Messrs. Gallenkamp in November. It reads $0^{\circ}04$ (F) lower than the Kew Standard, No. 647, at 60° F.

Hygrograph for Underground Room.—In November a small dry and wet bulb hygrograph, of the bi-metallic spiral type, was set up in the Underground Room. The record is obtained on a drum 5 inches high and $3\frac{1}{2}$ inches in diameter. Both dry and wet bulb records are time-scaled by an hourly signal from the mean time clock which operates an electro-magnet and causes the armature to engage in a toothed wheel concentric with the axis of the spiral thermometers. This moves the pen sufficiently to make a distinct mark on the paper, the record being quite smooth.

When the record shows rapid movements, such as in the case of an ordinary thermograph exposed to the outside air, the system of time-breaks is more satisfactory than time-marks.

Richard Thermograph.—The base lines laid down on the Richard thermograms from the hourly observations of rotating thermometers still show larger irregularities than might be expected, seeing that the thermograph is mounted in a well ventilated Indian pattern shed, and that the thermometers are aspirated automatically during the last five minutes of each hour.

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura pluviograph, the amount of sunshine by two Campbell-Stokes universal sunshine recorders, and the relative humidity of the air by a small Richard hair hygrograph. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hongkong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal features of the Weather.—The principal features of the weather in 1923, were:—

- (a) Drought in January, February, March and May, and abnormally heavy rains in June, July, August and October.

- (b) Large number of typhoons ; one of which, on August 18, caused considerable damage in Hongkong,
- (c) Abnormally high temperature in March, November and December.

Barometric pressure was moderately above normal in January, March and December, moderately below from April to July and considerably below in August and November. The mean pressure for the year at station level was $29\cdot828^{\text{ins.}}$ as against $29\cdot820^{\text{ins.}}$ in 1922 and $29\cdot842^{\text{ins.}}$ for the past 40 years. The highest pressure was $30\cdot311^{\text{ins.}}$ on December 30 as against $30\cdot445^{\text{ins.}}$ in 1922 and $30\cdot509^{\text{ins.}}$ for the past 40 years. The lowest pressure was $28\cdot590^{\text{ins.}}$ on August 18 (the lowest on record) as against $29\cdot174^{\text{ins.}}$ in 1922.

The temperature of the air was considerably above normal in March, November and December and moderately above in April and May. In the remaining months it was nearly normal. The mean temperature for the year was $72\cdot5$ as against $72\cdot4$ in 1922 and $71\cdot9$ for the past 40 years. The highest temperature was $92\cdot9$ on August 4, as against $93\cdot1$ in 1922 and $97\cdot0$ for the past 40 years. The lowest temperature was $45\cdot7$ on January 4 as against $43\cdot7$ in 1922 and $32\cdot0$ for the past 40 years.

The rainfall was moderately above normal in April, considerably above in July and very considerably above in August and October. It was considerably below normal in January, February, March and May. The total for the year was $106\cdot74^{\text{ins.}}$ as against $69\cdot43^{\text{ins.}}$ in 1922, and $84\cdot79^{\text{ins.}}$ for the past 40 years. The greatest fall in one civil day was $11\cdot50^{\text{ins.}}$ on October 31 and the greatest in one hour was $2\cdot82^{\text{ins.}}$ between 1.30 a.m. and 2.30 a.m. on October 31.

The wind velocity was very considerably below normal in September, considerably below in February and moderately below in January, May, October and December. It was very considerably above normal in July and considerably above in August. The mean velocity for the year was 12.2 m.p.h. as against 11.6 m.p.h. in 1922, and 12.6 m.p.h. for the past 40 years. The maximum velocity for one hour, as recorded by the Beckley Anemograph, was 106 miles at 10 a.m. on August 18 as against 55 miles in 1922 and 108 miles for the past 40 years. The maximum squall velocity as recorded by the Dines-Baxendell Anemograph, was at the rate of 130 m.p.h. at 10h. 13m. a.m. on August 18 (the highest on record) as against 75 m.p.h. in 1922.

Rainfall at Four Stations.—In the following table the monthly rainfall for the year 1923 at the Observatory is compared with the fall at the Police Station, Tai Po ; the Botanical Gardens ; and the Matilda Hospital, Mount Kellet :—

Months.	Observatory (Kowloon).	Police Station (Taipo).	Botanical Gardens (Hongkong).	Matilda Hospital (Hongkong).
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	0·130	0·53	0·21	0·20
February, ...	0·390	0·28	0·64	0·86
March,	0·660	0·40	0·84	0·60
April,	8·370	10·45	7·94	6·41
May,	3·795	4·49	4·36	3·86
June,	15·720	17·84	18·51	71·14
July,	18·525	28·57	20·43	11·58
August,	34·310	42·08	35·18	25·02
September,...	6·285	3·02	6·91	9·18
October,	17·835	9·00	12·84	18·05
November, ...	0·405	0·28	0·55	0·56
December, ...	0·315	0·08	0·63	0·54
Year....	106·740	117·02	109·04	94·00

Floods.—The heaviest rainfall occurred at the Observatory as follows :—

<i>Period.</i>				<i>Amount.</i>	<i>Duration.</i>	<i>Greatest fall in 1 hour.</i>			
						<i>Amount.</i>	<i>Time.</i>		
d.	h.		d. h.	inches.	hours.	inches.		d.	h.
April...12	3	to	April 13 21	5·26	30	2·17	April	12	5
May .. 30	1	to	June 4 19	4·50	51	0·61	June	1	18
June...12	11	to	June 15 9	7·45	37	1·19	June	14	10
July...20	18	to	July 23 10	6·29	32	0·60	July	23	5
July...26	5	to	July 31 20	9·61	59	0·81	July	27	13
Aug. ... 4	20	to	Aug. 6 10	6·86	32	0·83	Aug.	6	0
Aug. ...10	10	to	Aug. 19 4	10·55	35	1·25	Aug.	18	14
Aug. ...27	12	to	Aug. 31 14	15·87	76	1·58	Aug.	29	9
Oct. ...30	9	to	Oct. 31 9	16·09	22	2·82	Oct.	31	2

Serious floods and landslides were caused by these heavy rains.

Typhoons.—The tracks of 20 typhoons and 4 of the principal depressions which occurred in the Far East in 1923 are given in two plates in the Monthly Meteorological Bulletin for December, 1923.

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East for 6 a.m. of the 120th meridian, and the Daily Weather Report (containing meteorological observations, usually at 6^{h.} and 14^{h.}, from about 40 stations in China, Indo-China, Japan, the Philippines

and Borneo) and Daily Weather Forecasts for Hongkong to Gap Rock, the Formosa Channel, the south coast of China between Hongkong and Lamocks, and between Hongkong and Hainan, were issued as in former years. Copies of the map were exhibited on notice boards at the Hongkong Ferry Pier, Blake Pier, and the Harbour Office. One copy was sent daily to the Institute of Engineers and Ship-builders and one to the Director of the Meteorological Observatory, Macao. Forty copies of the Daily Weather Report were distributed to various offices, etc., in the Colony, and a copy was sent daily to the Director of the Meteorological Observatory, Macao. Copies were sent every week to the Hydrographic Office, Bangkok.

A charge of \$10 a year is made for supplying private firms and individuals with the Daily Weather Report, and \$36 for the Weather Map. No map was published on August 12, owing to the late arrival of weather telegrams. On several other occasions the map, though published, contained but meagre information.

The Weather Forecast is telegraphed daily to the Cape d'Aguilar Wireless Station in time for distribution at 1 p.m. It is broadcast again at 5 p.m.

An evening Weather Report and Forecast, based upon the 2 p.m., observations from about 30 stations, has been issued since June 1. It is broadcast by Cape d'Aguilar at 7 p.m., and repeated at 8 p.m.

Monthly Meteorological Bulletin.—The monthly Meteorological Bulletin, which includes the Daily Weather Report, was published as usual, and distributed to the principal observatories and scientific institutions in different parts of the world.

Monthly Seismological Bulletin.—The publication of a monthly seismological bulletin, giving particulars of earthquakes recorded by the Milne-Shaw seismograph, was continued throughout the year, and distributed to the principal seismological Observatories.

Miscellaneous Returns.—A monthly abstract of observations made at the Observatory is published in the Government Gazette, and monthly and yearly results are published in the Blue Book in the form suggested by the London Meteorological Office for the British Colonies. The monthly departures from normal of the barometric pressure at four China Coast Ports are communicated to the Commonwealth Meteorologist, Melbourne, in connection with long range weather forecasts. Monthly meteorological returns are forwarded to the Meteorological Magazine, and annual returns to the Stock Exchange Official Intelligence, the Colonial Office List and Whitaker's Almanack. Particulars of the calendar, eclipses, times of sunrise and sunset &c., are communicated to the "Directory and Chronicle" and the "Hongkong Dollar Directory."

V.—WEATHER TELEGRAMS, FORECASTS, AND STORM WARNINGS.

Daily Weather Telegrams.—The improvement in this service received a set back by the disastrous earthquakes near Yokohama on September 1—2. No weather telegrams were received from Japanese stations between September 1 and October 2.

On March 8 the service of weather telegrams from Wei Hai Wei ceased, owing to the closing of the Eastern Extension Telegraph Company's Office at this station, in view of the impending rendition of Wei Hai Wei. Through the courtesy of the Cable Company and the Chinese Maritime Customs this station was replaced by Chefoo from which weather telegrams have been promptly and regularly received since September 5.

A welcome addition to the list of telegraphic reporting stations is Basco, one of a group of islands midway between Luzon and Formosa. By the courtesy of the Director of the Philippines Weather Bureau observations from this station have been received, with few interruptions, since October 2, *via* Manila.

Occasionally belated weather telegrams are received from South China, but as a rule the observations from these districts are posted in batches to Hongkong, as are those from Central China.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rate during typhoons, on receipt of certain code words from Hongkong :—Amoy, Canton, Macao, Phulien, Sharp Peak, and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The extra 9 p.m. telegram from Swatow, kindly sanctioned by the Chinese Telegraph Administration during the typhoon season, was seldom received.

Weather Telegrams by Radio.—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately) :—

Month.	<i>British (including H.M. Ships).</i>		<i>Other National- ities.</i>		<i>Total</i>	
	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.
January,	12	31	37	62	49	93
February,	6	13	31	61	37	74
March,	7	20	30	48	37	68
April,	13	25	35	49	48	74
May,	7	10	28	40	35	50
June,	15	36	35	51	50	87
July,	30	55	46	73	76	128
August,	32	67	49	86	81	153
September,	22	42	27	42	49	84
October,	13	26	41	73	54	99
November,	20	36	47	72	67	108
December,	19	48	25	41	44	89
Totals 1923,	196	...	431	...	627	...
Totals 1922,	280	...	369	...	649	...
Totals 1921,	121	...	145	...	266	...
Totals 1920,	64	...	76	...	140	...
Totals 1919,	17	...	44	...	16	...

It will be seen that while the number of foreign ships sending weather reports by radio telegraphy has increased by 17%, the number of British ships has decreased by 30%.

This is a serious matter which is engaging the attention of the Government.

Results of Weather Forecasts.—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1918	71	26	3	0
1919	71	27	2	0
1920	64	30	5	1
1921	65	30	5	0
1922	67	30	3	0
1923	66	30	3	1

The forecast comprises wind direction, wind force, and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in 1918 Report.

Storm Warnings.—At the request of the Chamber of Commerce the Hongkong Government adopted the China Seas Storm Signal Code from 1920, June 1, in place of the Hongkong Non-Local Code introduced in 1917. The signals are displayed on Kowloon Signal Hill.

The following Ports are warned by a telegraphic adaptation of the code:—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phulien, Taihoku, Manila, Labuan, and Singapore. 218 storm warnings were sent in 1923 and 229 were received from Manila. 3 were received from Phulien, via Quang Chau Wan Radio Station.

Local typhoon signals are exhibited on the Observatory radio mast and repeated at the Harbour Office, H.M.S. *Tamar*, Green Island, the Godown Company, (Kowloon), Lyemun, and Lai Chi Kok, during the day.

The local night signals are exhibited on the Observatory Radio Mast and repeated on the tower of the Kowloon Railway Station, on H.M.S. *Tamar*, and at the Harbour Office.

A translation of the non-local and local storm warnings is exhibited at the Harbour Office, the General Post Office and the Star Ferry Piers and also sent to the Cape d'Aguilar Radio Station, whence it is broadcast at about noon and repeated every two hours until midnight. If a second warning is issued during the day the later warning is substituted.

When a local storm warning is displayed at the Observatory a cone is exhibited at several outlying stations for the benefit of native craft and passing ocean vessels.

In the following table is given the number of hours the local signal were hoisted in each of the years 1919-1923 :—

Year.	Red Signals.	Black Signals.	Bombs.
	Number of hours hoisted.		Number of times fired.
1919	78	105	1
1920	107	156	...
1921	94	121	...
1922	181	154	...
1923	181	252	2

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signal indicates that a depression exists which may possibly cause a gale at Hongkong within 24 hours. The black signals indicate that a gale is expected at Hongkong.

Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &c.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 178 ships operating in the Far East. These logs, representing 7139 days' observations, have been utilised for verifying typhoon tracks. The corresponding figures for the year 1922 were 172 and 5763.

Comparison of Barometers.—The corrections to ships' barometers are usually obtained by comparing their readings while at Hongkong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

VII.—MAGNETIC OBSERVATIONS.

Horizontal force, declination, and dip are observed once a month. In the dip observations 4 needles are used in rotation, the result for each month being the mean of determinations with two needles.

In the following table are given the annual values of the magnetic elements in 1923, as derived from observations made in the new magnetic hut with magnetometer Elliott 83 and dip circle Dover 71 :—

	1923.
	° /
Declination (west) - - - -	0.23.2
Dip (north) - - - -	30.44.7
Horizontal Force (C.G.S. unit) - -	0.37284
Vertical Force (C.G.S. unit) - -	0.22177
Total Force (C.G.S. unit) - - -	0.43381

The Horizontal Force and Declination observations were made with Magnets No. 83 from January to May inclusive. On May 16 the lens and scale of the collimator magnet were accidentally fractured and Magnets No. 55 were used in unifilar Elliott No. 83 from June until the end of the year.

The damaged magnet was sent to England for repair in January 1924.

VIII.—TIME BALL.

Time Ball.—The Time Ball on Kowloon Signal Hill is dropped at 10 a.m. and 4 p.m., daily, except on Saturdays when it is dropped at 10 a.m. and 1 p.m., and on Sundays and Holidays when it is dropped at 10 a.m. only. (120th Meridian Time).

The Ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

When the Time Ball is out of order the above routine is carried out with flag “Z”, on the storm signal mast. On no occasion was the flag system required in 1923.

Time Signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. From 8h. 56m. 0s. to 9h. 0m. 0s. p.m. the lamps are extinguished momentarily at the even seconds, except at the 2nd, 28th, 50th, 52nd, and 54th of each minute. The 9 p.m. signals were repeated at midnight on December 31, the last flash indicating the close of the year 1923. The hours refer to Hongkong Standard Time (8 hours East of Greenwich).

The Time Ball was dropped successfully 658 times. There was one failure; on November 23, when the handle of the winding gear was broken and it was impossible to raise the ball to the top of the mast by 10h. The handle was repaired by the Railway Department and replaced in time for the ball to be dropped at 16h. The ball was also dropped accidentally on November 20 at 15h. 57½m., but was raised and dropped correctly at 16h. On 9 occasions the ball was not raised owing to typhoon gales.

In the following table is given the number of times different errors occurred in the years 1922 and 1923.—

Error.	Number of Times.	
	1922	1923
0·3 sec. or less	633	604
0·4 "	10	29
0·5 "	6	12
0·6 "	2	7
0·7 "	...	4
0·8 "	1	...
0·9 "	1	2

The mean probable error of the time ball in each month for the past five years is given in the following table :—

Month.	Probable Error of the Time Ball.				
	1919	1920	1921	1922	1923
January,	±0·24	±0·17	±0·25	±0·10	±0·16
February,	·20	·30	·13	·15	·14
March,	·12	·21	·44	·12	·11
April,	·19	·15	·27	·20	·18
May,	·14	·17	·16	·10	·13
June,	·14	·13	·17	·11	·21
July,	·13	·22	·10	·14	·12
August,	·15	·11	·10	·10	·28
September,	·10	·24	·20	·15	·24
October,	·15	·15	·10	·10	·15
November,	·14	·19	·10	·17	·21
December,	·12	·13	·11	·10	·13
Means,	±0·15	±0·18	±0·18	±0·13	±0·17

Time Signal by Radio Telegraphy.—In addition to the time signals given by the Time Ball, and on the radio mast, signals are sent at 10h. and 21h. by radio telegraphy *via* Stonecutters. Particulars of the programme are given in the 1918 Report and in Government Notification No. 452 of 12.3.21. The service was transferred from Cape d'Aguilar to Stonecutters on May 1, 1921.

Radio Receiving Set.—The radio receiving set was in use throughout the year. 256 comparisons were obtained with the Manila Observatory clock *via* Cavite, and 5 with the Tokio Observatory clock, *via* Funabashi.

The mean of the comparisons makes Tokio 0.44 sec. fast and Manila 1.14 secs. fast on Hongkong. The corresponding figures in 1922 were 0.54 and 1.03.

Transit Instrument.—Observations for time were made chronographically by the Chinese computers, and were supplemented by eye and ear observations of the sun's limbs, circumpolar, and other stars made by the Chief Assistant for the purpose of checking the computers' observations, and determining the errors of the instrument.

The number of observations in the years 1922 and 1923 were as follows:—

	1922	1923
Transits - - - - -	1307	1424
Level determination - - - - -	696	787
Azimuth - - - - -	31	52
Collimation - - - - -	28	20

On January 11 the 3" transit instrument by Troughton and Simms was dismounted and sent to England for renovation by Messrs. Cooke, Troughton and Simms. A 2 $\frac{1}{4}$ " non-reversible transit by Dolland, kindly loaned by the Singapore Government, has been in use since that date. The observations made with this instrument by the Chinese computers have been extremely discordant and, in consequence, the pre-determination of clock errors has presented considerable difficulty.

Clocks.—The performance of the Standard Sidereal clock has been characterised by a steady increase in the daily losing rate for the past two years, apparently irrespective of any consideration of pressure, temperature or season. On November 8, 1923, the losing rate having increased to + 1.17 secs., 1.4 gramme was added to the pendulum. This altered the losing rate to—0.40 sec., which has since been maintained, with inconsiderable variations.

In the following table is given the excess of the observed over the computed error after cloudy periods during 1923 :—

Date 1923.		Interval without observations.	Excess of observed over computed error.
			<i>secs.</i>
January	3	2 days	+ 0'02
"	15	4 "	— 0'45
"	22	3 "	+ 0'20
"	25	2 "	+ 0'29
February	15	6 "	+ 0'04
"	23	7 "	+ 0'04
"	28	4 "	— 0'36
March	11	2 "	+ 0'24
"	16	4 "	+ 0'03
"	20	3 "	— 0'09
April	17	6 "	+ 0'15
"	22	3 "	+ 0'27
"	27	3 "	+ 0'25
May	3	3 "	+ 0'14
"	8	2 "	+ 0'39
June	4	3 "	+ 0'53
"	15	8 "	+ 0'09
"	27	5 "	— 0'10
July	5	5 "	+ 0'35
"	11	5 "	— 0'11
"	24	4 "	+ 0'11
"	31	5 "	+ 0'09
August	6	2 "	+ 0'24
"	20	10 "	— 0'95
"	23	2 "	— 0'49
September	2	7 "	— 0'62
"	15	2 "	+ 0'56
October	16	2 "	— 0'27
"	31	2 "	+ 0'27
November	16	2 "	— 0'33
"	26	2 "	— 0'18
December	3	3 "	— 0'42
"	10	4 "	+ 0'18

The Dent Mean Time clock (No. 39740) was used throughout the year for dropping the Time Ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10 a.m. and before 4 p.m. by the electric regulating apparatus. The daily rate of the pendulum is kept below 0'5 sec. by the addition or removal of weights.

Chronometer Dent No. 40917 is on loan to the Stonecutters Radio Station.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light

and Power Co. Ltd., by a rotary converter. For rectifying alternating current the converter has proved more economical than Nodon Valves, which were used only for charging the high tension battery of the radio receiving set, for which purpose the converter is unsuitable. Becoming gradually less efficient the valves were finally discarded in July in favour of a Tungar rectifier, which has worked satisfactorily.

IX.—MISCELLANEOUS.

Seismograph.—The Milne-Shaw seismograph received in December, 1922, was set up on the west side of the seismograph pier in the newly completed Underground Room on May 3. It is orientated to record movements in an East-West direction. The instrument received in September 1921 remained on a temporary mounting until August 8, in order that its records might be compared with those of the new instrument on the underground pier. It was then set up parallel to the new instrument on the same pier.

An examination of the records showed that during an earthquake, the movements of the two pendulums side by side, though generally similar, were not identical.

The older pendulum was mounted in its final position at right angles to the other pendulum on September 3, thus completing the outfit for obtaining the north and east components of earth movements.

The result of comparisons of the records of the instrument on the temporary and permanent mountings is given below :—

<i>Phenomenon.</i>	<i>Temporary mounting.</i>	<i>Underground Pier.</i>
Diurnal Tilt.	Very marked ; magnitude depending on daily range of temperature.	So small as to be usually unmeasurable.
Effect of typhoons.	Very marked ; large irregular movements superposed on tremor storms.	Only slight tremor storms.
Tremor Storms.	Very marked ; fairly frequent and occasionally lasting for several days at a time.	Very slight ; only occasional.
Irregular micro-seisms.	Very marked ; fairly frequent and occasionally lasting for several days at a time.	Very slight ; only occasional.

So far as I am aware this is the first time that direct comparisons between two such mountings has been made, though it has generally been conceded that a solid pier in an underground room is necessary for the satisfactory registration of earth movements.

141 earthquakes were recorded during the year, as against 144 in 1922. The seismograms have been forwarded to the President of the Seismological Committee, Oxford.

Upper Air Research.—49 flights with pilot balloons were made during the year. The results of the observations have been sent to the *Commission Internationale pour l'exploration de la haute atmosphere*, Kristiania.

Observations by the "tail" method have shown that the assumption of a constant rate of ascent is not justified. Observations with one theodolite therefore will not give results of the accuracy necessary in upper air research. An attempt is being made to secure observations with a second theodolite at a point about 3 miles to the NNW of the Observatory.

Staff.—No change occurred in the European staff. Mr. B. D. Evans, First Assistant, was on leave from February 21 to November 14.

Wan Suit Ngam, (IIIrd grade Telegraphist-computer) retired on January 31 and Lam Kai Tseung was promoted to IIIrd grade.

Lau Pak Wah and Chu Ip Sheung were promoted to Vth Grade on January 1. Chan Lai Man was appointed IVth Grade Telegraphist-Computer on 1922, December 7.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows :—

Year.	Total Expenditure.		Increase.		Decrease.	
	\$	c.	\$	c.	\$	c.
1914	25,398.	31	1,142.	82	.....
1915	23,233.	12	.....		2,165.	19
1916	21,977.	78	.....		1,255.	34
1917	26,890.	50	4,192.	72	.....
1918	20,028.	24	.....		6,862.	26
1919	23,450.	57	3,422.	33	.....
1920	25,965.	66	2,515.	09	.....
1921	32,700.	51	6,734.	85	.....
1922	38,350.	10	5,649.	59	.....
1923	38,522.	58	172.	48	.....

Acknowledgements.—Acknowledgements are here made to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs authorities, for daily observations and extra observations during typhoon weather, to the Telegraph Companies for transmitting the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties.

T. F. CLAXTON,
Director.

1924, February 20.

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REPORT OF THE DIRECTOR OF THE ROYAL OBSERVATORY, HONGKONG, FOR THE YEAR 1924.

I.—GROUNDS AND BUILDINGS

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

Underground Chamber for Seismograph and Clocks.—As the scale value of the thermograph supplied by Messrs. Short and Mason was too small for satisfactory registration of the minute changes of temperature in the Underground Chamber, magnifying levers were constructed and fitted by Mr. Evans. In October, after several trials, with levers of various dimensions, counterpoised and uncounterpoised, and the introduction of a buzzer, he succeeded in obtaining satisfactory registration with a scale value of 0.6 inch to 1° (C). The buzzer is fixed on a brass frame screwed to the supports of the dry and wet bulb thermometers. It is operated for 1 sec. every minute. Such high magnification is only feasible in conjunction with a buzzer, or other device for overcoming the combined effects of inertia and friction.

The records are standardized by 4-hourly readings of dry and wet bulb thermometers, graduated to 0.1 (C) and read to 0.01 (C) by estimation. They show that the diurnal inequality of temperature in the Underground Chamber is small, but greater than indicated by the thermograph in its original condition.

In the following table the mean temperature of the air and humidity, at 4-hourly intervals, for November and December, 1923, are compared with the corresponding figures for 1924 :—

Month and Year		Temperature of air in Underground Chamber.						
		0.	4h.	8h.	Noon.	16h.	20h.	Range.
Nov.	1923	75.28	75.23	75.24	75.25	75.27	75.23	0.05
	1924	76.23	76.23	76.23	76.15	76.25	76.32	0.17
Dec.	1923	72.72	72.64	72.63	72.66	72.68	72.68	0.09
	1924	72.93	72.82	72.86	72.90	72.88	72.95	0.13

Month and Year		Relative Humidity in Underground Chamber.						
		0h.	4h.	8h.	Noon.	16h.	20h.	Range.
Nov.	1923	% 80·6	% 80·2	% 80·0	% 78·1	% 78·0	% 78·8	% 2·6
	1924	66·8	66·3	64·7	63·8	64·7	66·3	3·0
Dec.	1923	73·5	73·5	73·0	72·9	71·7	72·2	1·8
	1924	60·9	60·8	60·3	58·7	59·5	60·4	2·2

In the following table the mean monthly temperature and humidity in the Underground Chamber are compared with the temperature and humidity in the open air. As the air in the Underground Chamber is always still, humidity tables for calm air have been computed and used for obtaining the relative humidity from the readings of these dry and wet bulb thermometers.

Mean Monthly Temperature and Relative Humidity in the Underground Chamber and in the Open Air, during the year 1924.

Month 1924.	In Underground Chamber.		In Open Air.		Excess of Underground Chamber over Open Air.	
	Temperature	Relative Humidity	Temperature	Relative Humidity	Temperature	Relative Humidity
		%		%		%
January, ...	70·6	76	62·4	81	+ 8·2	— 5
February,...	69·1	79	60·3	86	+ 8·8	— 7
March,.....	68·7	79	62·5	79	+ 6·2	0
April,	70·4	88	69·3	85	+ 1·1	+ 3
May,	74·5	95	79·6	82	— 5·1	+ 13
June,	77·0	94	80·5	83	— 3·5	+ 11
July,.....	79·7	94	81·7	83	— 2·0	+ 11
August, ...	80·5	92	81·9	82	— 1·4	+ 10
September,.	80·6	89	82·2	78	— 1·6	+ 11
October, ...	79·1	81	76·5	71	+ 2·6	+ 10
November,...	76·3	65	68·2	57	+ 8·1	+ 8
December,...	72·9	60	61·9	61	+ 11·0	— 1
Range.....	11·9	35	21·9	29	...	...

It will be seen that while the range of temperature in the Underground Chamber is only a little more than half the range in

the Open Air, the range of relative humidity is actually greater. It is hoped however that the excessive dampness during the summer months may be reduced by a heating element which has recently been installed along the outside of the inner wall at a height of $1\frac{1}{2}$ feet from the floor. It is to be controlled by a thermostat, but the instrument sent out was found to be unsatisfactory so has been sent back to the makers for alterations.

Beginning with 1925, February 1st, the records have been standardized only by eye observations on entering and leaving the room for the purpose of changing the seismograph sheets.

II.—METEOROLOGICAL INSTRUMENTS.

Barometers.—The Marvin compensated syphon barometer has worked satisfactorily.

The station barometer No. 1323 and the large Casella barometer were compared with the Observatory Standard on May 19th.

Beckley Anemograph.—This instrument was oiled and the orientation of the vane checked once a month.

Dines-Baxendell Anemograph.—The bearings of the vane were oiled and its orientation checked once a month. The spindle of the float was cleaned and oiled once a week.

The Mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1923 are given in the following table, together with the results for 1924 :—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor ($\text{Dines} \div \frac{\text{Beckley}}{\text{}} \text{}$).	
	Mean 1910-1923.	1924.
January,	1.96	1.64
February,	2.01	1.57
March,	2.05	1.79
April,	2.07	1.70
May,	2.16	2.13
June,	2.07	2.22
July,	2.18	2.49
August,	2.11	2.60
September,	2.12	2.46
October,	2.05	2.18
November,	1.96	2.15
December,	1.92	1.94
Year	2.06	2.07

The Annual Values are given below.—

<i>Year.</i>	<i>Factor.</i>	<i>Year.</i>	<i>Factor.</i>
1910	2.25	1918	2.06
1911	2.27	1919	1.97
1912	2.42	1920	1.72
1913	2.39	1921	1.74
1914	2.22	1922	1.81
1915	2.11	1923	1.67
1916	2.30	1924	2.07
1917	1.95		

The figures may be grouped into three periods ; 1910—1916, 1917—1919 and 1920—1923. The means for these periods are 2.27, 1.99 and 1.73.

No explanation of these relatively large variations can be given. The instrument is carefully tended, and calibrated once a year.

As an instance of the baffling behaviour of this instrument it may be mentioned that in January and February the factor showed a distinct variation with velocity, whereas in August and December although large variations occur they appear to be independent of the velocity.

The scale value of the direction apparatus was halved on August 15th, to obviate loss of register owing to the pen travelling off the sheet in variable winds.

Thermometers.—All thermometers in use are compared with Kew Standard No. 647 in winter and summer.

Richard Thermograph.—A buzzer, operated each minute, was fitted to the thermometer frames on April 2nd, but the base lines laid down on the thermograms from the hourly observations of rotating thermometers still show large irregularities except on dull days, with a small range of temperature.

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell Anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura pluviograph, the amount of sunshine by two Campbell-Stokes universal sunshine recorders, and the relative humidity of the air by a small Richard hair hygrograph. Eye observations of

barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hongkong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal features of the Weather.—The principal features of the weather in 1924 were :—

- (a) Absence of typhoons.
- (b) Heavy rain in May, June, July and August.
- (c) A heat wave from August 28 to September 10.

Barometric pressure was considerably below normal in February, particularly from the 6th to the 10th and from the 18th to the 23rd. It was moderately above in March and moderately below in April, gradually regaining normal by August. It was moderately above normal in September and November. The mean pressure for the year at station level was $29\cdot830^{\text{ins.}}$ as against $29\cdot828^{\text{ins.}}$ in 1923 and $29\cdot842^{\text{ins.}}$ for the past 41 years. The highest pressure was $30\cdot314^{\text{ins.}}$ on November 24 as against $30\cdot311^{\text{ins.}}$ in 1923 and $30\cdot509^{\text{ins.}}$ for the past 41 years. The lowest pressure was $29\cdot365^{\text{ins.}}$ on July 15, as against $28\cdot590^{\text{ins.}}$ in 1923, the lowest on record.

The temperature of the air was moderately above normal in January, February, May and September, and slightly below in March, April, June, November and December. The mean temperature for the year was $72^{\circ}\cdot3$ as against $72^{\circ}\cdot5$ in 1923 and $71^{\circ}\cdot9$ for the past 41 years. The highest temperature was $93^{\circ}\cdot2$ on September 7, as against $92^{\circ}\cdot9$ in 1923 and $97^{\circ}\cdot0$ for the past 41 years. The lowest temperature was $47^{\circ}\cdot5$ on January 1 as against $45^{\circ}\cdot7$ in 1923 and $32^{\circ}\cdot0$ for the past 41 years. The heat wave from August 28 to September 10 was exceptional. The mean temperature for September 7, $87^{\circ}\cdot5$ was the highest on record for any month and the maximum on this day, $93^{\circ}\cdot2$, has only been exceeded in September on two occasions, namely on September 6, 1895, when it was $94^{\circ}\cdot0$ and on September 17, 1892, when it was $93^{\circ}\cdot9$. The night of September 7-8, was the hottest on record for any month, the minimum being $84^{\circ}\cdot3$. The next hottest was 1915, August 7-8, when the minimum temperature was $83^{\circ}\cdot7$.

The rainfall was moderately above normal in February and October and considerably above normal in May, June and July. It was moderately below normal in March, August and September. No rain fell from 5 a.m. on October 18 to 5 p.m. on December 3. The total for the year was 98·57^{ins.} as against 106·74^{ins.} in 1923 and 85·13^{ins.} for the past 41 years. The greatest fall in one civil day was 6·60^{ins.} on June 23 as against 20·495^{ins.} for the past 41 years and the greatest in one hour was 1·74^{ins.} between 12·30 p.m. and 1·30 p.m. on May 22, as against 3,480^{ins.} for the past 41 years.

The wind velocity was normal in January and November, moderately above normal in June and slightly to moderately above normal in the other months. The mean velocity for the year was 11·7 m.p.h. as against 12·2 m.p.h. in 1923, and 12·6 m.p.h. for the past 41 years. The maximum velocity for one hour, as recorded by the Beckley Anemograph, was 46 miles at midnight and 2 a.m. on October 4 and 5 respectively as against 106 miles in 1923, and 108 miles for the past 41 years. The maximum squall velocity as recorded by the Dines-Baxendell Anemograph, was at the rate of 69 m.p.h. at 1·55 a.m. on October 5, as against 130 m.p.h. in 1923, the highest on record.

Rainfall at Four Stations.—In the following table the monthly rainfall for the year 1924 at the Observatory is compared with the fall at the Police Station, Tai Po; the Botanical Gardens; and the Matilda Hospital, Mount Kellet :—

Month.	Observatory (<i>Kowloon</i>).	Police Station (<i>Taipo</i>).	Botanical Gardens (<i>Hongkong</i>).	Matilda Hospital (<i>Hongkong</i>).
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	1·080	1·44	1·59	1·48
February, ...	4·510	8·02	4·50	3·80
March,	0·180	1·82	0·26	0·23
April,	6·215	5·23	4·89	4·20
May,	16·875	11·24	15·97	15·20
June,	23·140	24·86	25·05	23·47
July,	19·675	15·43	18·24	18·31
August,	10·655	9·50	14·29	13·05
September,...	6·440	5·55	10·28	10·01
October,	9·090	12·22	9·70	13·58
November, ...	.....	.....	.....	.....
December, ...	0·710	1·05	0·74	0·95
Year....	98·570	96·36	105·51	104·28

Floods.—The heaviest rainfall occurred at the Observatory as follows :—

<i>Period.</i>			<i>Amount.</i>		<i>Duration.</i>		<i>Greatest fall in 1 hour.</i>	
							<i>Amount.</i>	<i>Time.</i>
d.	h.		d.	h.	inches.	hours.	inches.	d. h.
May ...15	1	to	May 16	3	3.49	12	0.74	May 15 4
May ...21	10	to	May 24	13	9.90	28	1.74	May 22 13
June ...11	21	to	June 13	23	3.74	34	0.77	June 12 6
June ...18	13	to	June 24	12	13.14	59	0.30	June 19 16
July ...12	4	to	July 17	10	6.75	19	1.20	July 15 13
July ...19	11	to	July 28	13	9.21	52	0.69	July 25 13
Aug. ... 8	11	to	Aug. 12	22	5.79	33	1.08	Aug. 12 18
Sept ...30	23	to	Oct 6	9	8.57	37	1.20	Oct. 5 9

Serious floods and landslides were caused by these heavy rains.

Typhoons.—The tracks of 14 typhoons and 21 of the principal depressions which occurred in the Far East in 1924 are given in two plates in the Monthly Meteorological Bulletin for December, 1924.

Hongkong was not visited by a typhoon during the year. The greatest squall velocity as recorded by the Dines Anemograph was at the rate of 69 m.p.h. at 1.55 a.m. on October 5, when a typhoon was 300 miles S.W. of Hongkong. The typhoons of July 10-17, August 2-6 and August 8-22 followed abnormal tracks, the first and last named making complete loops.

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East for 6 a.m. of the 120th meridian, and the Daily Weather Report (containing meteorological observations, usually at 6h. and 14h. from about 40 stations in China, Indo-China, Japan, the Philippines and Borneo) and Daily Weather Forecasts for Hongkong to Gap Rock, the Formosa Channel, the south coast of China between Hongkong and Lamocks, and between Hongkong and Hainan, were issued as in former years. Copies of the map were exhibited on notice boards at the Hongkong Ferry Pier, and the Harbour Office. One copy was sent daily to the Institute of Engineers and Shipbuilders, one to the Director of the Meteorological Observatory, Macao, one to the Diocesan Boys School, and one to the Central British School (since October 28). Copies of the Daily Weather Report were sent every week to the Hydrographic Office, Bangkok.

A lithographic machine for lithographing the weather map was received from Messrs. Ullmer & Co. on April 23, and set up in a special room on April 26-28.

Since July 3, the Map has been distributed to all subscribers to the "Daily Bulletin" and since July 14 the morning weather report has been printed on the back of the Map.

Since November 10 the Map has also been exhibited at the Kowloon Ferry Wharf.

The Weather Report and Forecast is telegraphed daily to the Cape d'Aguilar Wireless Station in time for distribution at 1 p.m. It is broadcast again at 5 p.m.

An evening Weather Report and Forecast, based upon the 2 p.m. observations from about 30 stations, has been issued since 1923, June 1. It is broadcast by the Cape d'Aguilar at 8 p.m., and since December 15 has been repeated at midnight.

Monthly Meteorological Bulletin.—The monthly Meteorological Bulletin, which includes the Daily Weather Report, was published as usual, and distributed to the principal observatories and scientific institutions in different parts of the world.

Monthly Seismological Bulletin.—The publication of a monthly seismological bulletin, giving particulars of earthquakes recorded by the Milne-Shaw seismograph, was continued throughout the year, and distributed to the principal seismological Observatories.

Miscellaneous Returns.—A monthly abstract of observations made at the Observatory is published in the Government Gazette, and monthly and yearly results are published in the Blue Book in the form suggested by the London Meteorological Office for the British Colonies. The monthly departures from normal of the barometric pressure at four China Coast Ports are communicated to the Commonwealth Meteorologist, Melbourne, in connection with long range weather forecasts. Monthly meteorological returns are forwarded to the Meteorological Magazine, and annual returns to the Stock Exchange Official Intelligence, the Colonial Office List and Whitaker's Almanack. Particulars of the calendar, eclipses, times of sunrise and sunset &c. are communicated to the "Directory and Chronicle" and the "Hongkong Dollar Directory".

V.—WEATHER TELEGRAMS. FORECASTS AND STORM WARNINGS.

Daily Weather Telegrams.—Additional observations at 11h. and 17h., Hongkong Standard time, have been received regularly from Phu-lien since January 5, from Tourane and Cape St. James since February 1, from Shanghai and Gutzlaff since April 1. A similar service from Amoy is expected shortly. Observations from Hankow have been promised, but have not yet been received owing to the disturbed state of China.

Occasionally belated weather telegrams are received from South China, but as a rule the observations from these districts are posted in batches to Hongkong, as are those from Central China.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rate during typhoons, on receipt of certain code words from Hongkong:—Amoy, Canton, Macao, Phulien, Sharp Peak, and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The extra 9 p.m. telegram from Swatow, kindly sanctioned by the Chinese Telegraph Administration during the typhoon season, was seldom received.

Weather Telegrams by Radio.—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately):—

Month.	<i>British (including H.M. Ships).</i>		<i>Other National- ities.</i>		<i>Total.</i>	
	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.
January,	12	21	36	64	48	85
February,	16	45	37	66	53	111
March,	22	46	38	60	60	106
April,	20	33	22	36	42	69
May,	26	53	30	53	56	106
June,	48	85	61	94	109	179
July,	130	317	113	205	243	522
August,	108	272	124	255	232	527
September,	80	211	102	193	182	404
October,	87	250	117	255	204	505
November,	50	153	78	181	128	334
December,	66	217	94	205	160	422
Totals {	1924,	665	...	852	...	1517
	1923,	196	...	431	...	627
	1922,	280	...	369	...	649
	1921,	121	...	145	...	266
	1920,	64	...	76	...	140

Beginning with April 25 all radio weather reports from ships were broadcast at 8 a.m. and 4 p.m., but as the Manila Authorities were unable to pick up the messages the practice was discontinued on 11th October.

The question of regular observations from ships by wireless telegraphy was taken up vigorously by the Chamber of Commerce, with the gratifying result indicated by the above table.

There is still room for improvement however. A Notice to Mariners giving particulars of what information is required is handed to masters of vessels by the Harbour Department. Copies are also sent to the shipping companies for distribution to their Captains. Supplies are also sent to the Master Attendant, Singapore, who has kindly consented to furnish copies to north bound ships.

An attempt is being made to standardize the form in which weather telegrams are sent out from ships. It is hoped that this will make the work less onerous and also diminish the risk of error.

Results of Weather Forecasts.—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, with the results of the previous five years :—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1919	71	27	2	0
1920	64	30	5	1
1921	65	30	5	0
1922	67	30	3	0
1923	66	30	3	1
1924	71	24	5	0

The forecast comprises wind direction, wind force, and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Special forecasts were issued to Majors MacClaren and Zanni in connection with their world flights.

Storm Warnings.—The symbols of the China Seas Storm Signal Code are displayed on Kowloon Signal Hill.

The following Ports are warned by a telegraphic adaptation of the code:—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phulien, Taihoku, Manila, Labuan, and Singapore. 194 storm warnings were sent in 1924, 186 were received from Manila, and 65 from Zikawei. 14 were received from Phulien, *via* Quang Chau Wan Radio Station.

The Day Signals of the Local Code are displayed at the following stations:—

Royal Observatory	Harbour Office
H. M. S. Tamar	Green Island
Gough Hill	Hongkong & Kowloon, Wharf
Standard Oil Co.,	& Godown Co., Kowloon.
Lai-Chi-Kok	Field Officer's Quarters,
	Lyemun.

The Night Signals are displayed, at sunset, at the following stations:—

Royal Observatory	H. M. S. Tamar
Harbour Office	Gough Hill
Railway Station	

They have the same signification as the day signals.

A translation of both Day and Night Signals is displayed at the General Post Office and at the Upper Tram Station.

When local signals are displayed in the Harbour a Cone is exhibited at the following stations:—

Gap Rock	Stanley	Sau Ki Wan	Sha Tau Kok
Waglan	Aberdeen	Sai Kung	Tai Po

In the following table is given the number of hours the local signal were hoisted in each of the years 1920-1924:—

Year.	Red Signals.	Black Signals.	Bombs.
	Number of hours hoisted.		Number of times fired.
1920	107	156	...
1921	94	121	...
1922	181	154	...
1923	181	252	2
1924	186	85	...

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signal indicates that a depression exists which may possibly cause a gale at Hongkong within 24 hours. The black signals indicate that a gale is expected at Hongkong.

Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &C.

Logs Received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 190 ships operating in the Far East. These logs, representing 7,222 days' observations, have been utilised for verifying typhoon tracks. The corresponding figures for the year 1923 were 178 and 7,139.

Comparison of Barometers.—The corrections to ships' barometers are usually obtained by comparing their readings while at Hongkong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

VII.—MAGNETIC OBSERVATIONS.

Horizontal force, declination, and dip are observed once a month. In the dip observations 4 needles are used in rotation, the result for each month being the mean of determinations with two needles.

In the following table are given the annual values of the magnetic elements in 1924, as derived from observations made in the new magnetic hut with magnetometer Elliott 83 and dip circle Dover 71 :—

Declination (west)	-	-	-	-	0.23 .8
Dip (north)	-	-	-	-	30.42 .8
Horizontal Force (C.G.S. unit)	-	-	-	-	0.37291
Vertical Force (C.G.S. unit)	-	-	-	-	0.22155
Total Force (C.G.S. unit)	-	-	-	-	0.43378

The vibration and declination observations were made with vibration magnet No. 55, and the deflections with deflection magnet No. 55 in unifilar Elliott No. 83.

Magnet No. 83 which was damaged in 1923, was repaired in England and used on return for declination observations in the New Territory, made with a view to selecting a site for a new Magnetic Observatory. Observations were made in the vicinity of Fanling and Castle Peak on eight occasions. No evidence of serious local magnetic attraction is shown at either site. The site must be accessible, as the photographic sheets of the magnetograph must be changed daily and absolute observations of Horizontal

Force, Dip and Declination must be made by one of the European staff at least once a week. The site must not only be free from any local magnetic attraction but must be safeguarded from possible building encroachment in the future.

VIII.—TIME SERVICE.

Time Ball.—The Time Ball on Kowloon Signal Hill is dropped at 10 a.m. and 4 p.m., daily, except on Saturdays when it is dropped at 10 a.m. and 1 p.m., and on Sundays and Holidays when it is dropped at 10 a.m. only (120th Meridian Time).

The Ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

The flag system was in use from May 12 to 21, during repairs to the timeball apparatus.

Time Signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. Until November 30, the lamps were extinguished momentarily at the even seconds, except at the 2nd, 28th, 50th, 52nd and 54th of each minute, from 8h. 56m. 0s. to 9h. 0m. 0s. p.m. From December 1st, the Manila system was in operation wherein the lights are extinguished every second, from 8h. 55m. to 9h. 0m. p.m., except at the 28th, 29th, 54th, 56th, 57th, 58th and 59th seconds. The 9 p.m. signals were repeated at midnight on December 31st, the last flash indicating the close of the year 1924. The hours refer to Hongkong Standard Time (8 hours East of Greenwich).

The Time Ball was dropped successfully 649 times. There were three failures; on May 22nd, at 4 p.m., June 26th at 4 p.m. and December 18th at 10 a.m., one being caused by electrical defects, the remainder being due to negligence of the computer in charge at the tower. The ball was dropped successfully at the subsequent hour on each occasion. It was not raised on October 4th at 1 p.m. owing to high winds.

In the following table is given the number of times different errors occurred in the years 1923 and 1924.

Error.	Number of Times.	
	1923	1924
0·3 sec. or less	604	530
0·4 "	29	44
0·5 "	12	37
0·6 "	7	23
0·7 "	4	10
0·8 "	...	5
0·9 "	2	...

The mean probable error of the time ball in each month for the past five years is given in the following table:—

Month.	Probable Error of the Time Ball.				
	1920	1921	1922	1923	1924
January,	± 0.17	± 0.25	± 0.10	± 0.16	± 0.26
February, .....	.30	.13	.15	.14	.13
March, .....	.21	.44	.12	.11	.17
April, .....	.15	.27	.20	.18	.27
May, .....	.17	.16	.10	.13	.23
June, .....	.13	.17	.11	.21	.27
July, .....	.22	.10	.14	.12	.21
August, .....	.11	.10	.10	.28	.16
September, .....	.24	.20	.15	.24	.13
October, .....	.15	.10	.10	.15	.18
November, .....	.19	.10	.17	.21	.14
December, .....	.13	.11	.10	.13	.12
Means,	± 0.18	± 0.18	± 0.13	± 0.17	± 0.19

Time Signals by Radio-Telegraphy.—In addition to the time signals given by the Time Ball, and on the radio mast, signals are sent at 10h. and 21h. by radio telegraphy *via* Stonecutters. Particulars of the programme are given in Government Notifications No. 359 of 13.6.24. and No. 637 of 14.11.24.

Radio Receiving Set.—The radio receiving set was removed to the old telescope house upon the west lawn on April 30 and operated since that date by the Public Works Department. The telephone lines are extended to the clock room so that time signals may be observed as before with the added advantage of expert tuning.

242 comparisons were obtained with the Manila Observatory *via* Cavite. The mean result makes Manila 0.88 sec. fast on Hongkong. It should be noted, however, that the comparisons fall into two distinct groups as follows.—

	No. of Comparisons.	Mean Result.
		Secs.
January to April (inclusive)	100	Manila 1.20 fast on H.K.
May to December (inclusive)	142	Manila 0.67 fast on H.K.

No change has been made in the time service routine at this Observatory. The actual change appears to have occurred on or about April 25th, 5 days before the transfer of the receiving set to fresh quarters.

Between September 3 and November 1, 13 comparisons were obtained with Bordeaux, by means of observed coincidences of the Dent Sidereal clock with the rhythmic beats emitted by Bordeaux. The results are in close agreement, and, assuming the correctness of the Bordeaux signal, the E. longitude of Hongkong would appear to be 0.56^{sec} . too great. A similar investigation of 26 comparisons with Tokio makes the Hongkong longitude E. 0.59^{sec} . too great, although the agreement of the observations leaves much to be desired, no doubt owing to the nature of the Tokio signals (a dash of 1 second duration at the termination of each minute.)

Transit Instrument.—Observations for time were made chronographically by the Chinese computers, and were supplemented by eye and ear observations of the sun's limbs, circumpolar, and other stars made by the Chief Assistant for the purpose of checking the computers' observations, and determining the errors of the instrument.

The number of observations in the years 1923 and 1924 were as follows :—

	1923	1924
Transits,	1424	1447
Level determination,	787	864
Azimuth,	52	69
Collimation,	20	66

The renovated Troughton and Simms transit instrument was received from England on March 31 and brought into regular use on April 9. There are two eye ends—one arranged for automatic registration, on the chronograph, of each revolution of the micrometer head as a travelling wire crosses the field, and one for ordinary manual signals by a taper key. The latter has not been in use to date as the former is easily adaptable to observing by either method. Observations made by means of the travelling wire were made until August 18, since when the taper has been used as formerly; the Chinese staff not acquiring the necessary dexterity in the manipulation of the travelling wire. It is proposed to make a further trial with the travelling wire micrometer when the Chinese staff have had more experience with the instrument.

The $2\frac{1}{4}$ non-reversible transit by Dolland, kindly loaned by the Singapore Government was returned early in April.

Clocks.—The performance of the Standard Sidereal Clock (Dent 39741) has been characterised by a steady increase in the losing rate since April. It varied from -0.70^{sec} . on April 2 (Bar. 29.54 Temp. 72.0°F) to $+0.31^{\text{sec}}$. on December 17 (Bar. 30.10 Temp. 65.0°F). This approximates to its performance during the last two years.

In the following table is given the excess of the observed error of Dent No. 39741 over the computed error during cloudy periods in 1924 :—

Date 1924.		Interval without observations.	Excess of observed over computed error.
			<i>secs.</i>
January	16	2 days	— 0'09
"	28	9 "	— 0'50
February	1	3 "	— 0'37
"	9	5 "	+ 0'38
"	19	9 "	— 0'08
"	26	6 "	— 0'03
March	3	2 "	— 0'07
"	9	2 "	+ 0'10
"	21	11 "	— 0'24
"	25	3 "	— 0'03
April	10	14 "	— 0'37
"	13	2 "	— 0'32
"	19	5 "	+ 0'27
"	29	4 "	+ 0'40
May	4	4 "	+ 0'77
"	8	3 "	+ 0'10
"	17	4 "	+ 0'98
"	24	2 "	+ 0'66
"	31	3 "	+ 0'10
June	24	15 "	+ 0'32
July	16	4 "	+ 0'46
"	22	3 "	+ 0'02
"	25	2 "	— 0'23
August	9	5 "	+ 0'02
"	25	2 "	+ 0'25
September	13	3 "	— 0'13
"	17	2 "	— 0'20
October	6	3 "	+ 0'31
"	12	3 "	— 0'24
November	23	2 "	+ 0'40
December	7	4 "	+ 0'37

The new Sidereal clock (Cottingham and Mercer No. 507) was received on December 12. It is of the Cottingham type and was constructed by Mr. Thomas Mercer of St. Albans. The pendulum and movement are enclosed in an hermetically sealed case in which the pressure of the air can be regulated as desired. Driving power is supplied by a gravity arm remounted electrically every 36 seconds. At the termination of the year 1924, adjustments were in progress. It is hoped to bring the clock into regular use early in 1925, and to take the opportunity of thoroughly overhauling Dent No. 39741.

The Mean Time clock (Dent No. 39740) was in use until November 30, for dropping the Time Ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10 a.m. and before 4 p.m. by the electric regulating apparatus. The daily rate of the pendulum is kept below $0\cdot5^{\text{sec.}}$ by the addition or removal of weights.

Since December 1, Mean Time clock (Leroy No. 1350) has been used for the above purpose. This clock was received on September 23, and operates the time service through two dials with half second pendulums which it effectually drives and synchronises by means of an electric impulse each second. It also actuates an apparatus for emitting Radio time signals in accordance with the new International System (See Government Notification No. 637 of 14.11.24).

The Brock clock was mounted in the seismograph underground room on January 10, for use in connection with the seismograph.

Chronometer Dent No. 40917 is on loan to Stonecutters Radio Station, and Dent No. 40912 is on loan to the P.W.D. Radio Station at the Observatory.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light and Power Co. Ltd., by a rotary converter. The Tungar rectifier and 3 Delco Cells are on loan to the P.W.D. radio station at the Observatory.

IX.—MISCELLANEOUS.

Seismograph.—149 earthquakes were recorded during the year by the Milne-Shaw Seismograph, as against 141 in 1923. The seismograms have been forwarded to the President of the Seismological Committee, Oxford. A slight earthquake shock was felt at 10.45 p.m. on January 10.

Upper Air Research.—49 flights with pilot balloons were made during the year. The results of the observations have been sent to the *Commission Internationale pour l'exploration de la haute atmosphere*, Kristiania.

Flying Officers Martin and Isaacs of H.M.S. Pegasus visited the Observatory on December 1 and 12 and kindly furnished copies of temperature observations made during four flights over Hongkong. The results are shown graphically on two charts appended to this Report.

Peak Anemograph.—The Anemograph at the Peak Signal Station was repaired by the Public Works Department and brought into use again on January 14.

Transit of Mercury.—On May 8 the sun rose with Mercury on its disc. Passing clouds were prevalent throughout the morning. From transient views of the sun from 1.30 p.m. the estimated time of external contact at egress was 1h. 36m. 16s., as compared with the computed time of 1h. 38m. 5s.

Visit to other Observatories.—In May and June, the Director visited the Observatories at Shanghai, Peking and Kobe.

The Director of the Peking Observatory very kindly promised to send twice daily to the Hongkong Observatory weather telegrams from Taiying, Kalgan, Shanghai-Kwang and Newchang. They have since been received sporadically in batches. They would be an invaluable addition to the Chefoo observations if received in time for the Daily Weather Maps.

The Director of the Kobe Observatory was asked to consider the possibility of adopting the Hongkong code for the daily weather telegrams, by which pressure, temperature, humidity, wind direction and force, and weather, can be transmitted by means of 6 letters, whereas the code used by the Japanese Authorities gives only pressure and wind direction and force, by means of 4 letters.

Negotiations on this subject, and also on the subject of observations from the Loochoos and Ishigakijima at additional hours are still pending.

The question of an uniform procedure on the matter of wireless time signals was discussed with the Directors of the Kobe and Shanghai Observatories. It is desirable that its probable error should be signalled immediately after the time signal, and also that the exact error should be circulated later. It is also desirable to know whether the signal sent is based on a computed clock correction or in cases of cloudy weather, for instance, a clock error obtained from wireless time signals from other Observatories.

Arrangements were made with the Director of the Shanghai Observatory for the exchange of typhoon warnings and for observations at additional hours from Shanghai, Gutzlaff, Hankow, and Amoy.

The question of a wireless station on the Pratas Shoal was discussed with the Inspector General of Maritime Customs and the Coast Inspector. There are hopes of its early erection by the Chinese Customs.

Visitors.—22 boys of the Diocesan School visited the Observatory on January 24. 20 boy scouts on July 29, a like number from the Chinese Y.M.C.A. on October 4 and 25 boys from St. Stephen's College on November 1.

Staff.—No change occurred in the European Staff during the year. Mr. C. W. Jeffries acted as Director of the Observatory during the absence of Mr. T. F. Claxton from May 19 to June 23 and Mr. B. D. Evans acted as Chief Assistant.

Chan Lai Man, IVth class Telegraphist-Computer resigned on August 9.

Chan Ying Yau and Lok Kwai Man were appointed Vth class Telegraphist-Computers, on October 1.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows :—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1915	23,233.12	.....	2,165.19
1916	21,977.78	.....	1,255.34
1917	26,890.50	4,192.72	.....
1918	20,028.24	.....	6,862.26
1919	23,450.57	3,422.33	.....
1920	25,965.66	2,515.09	.....
1921	32,700.51	6,734.85	.....
1922	38,350.10	5,649.59	.....
1923	38,522.58	172.48	.....
1924	52,638.49	14,115.91	.....

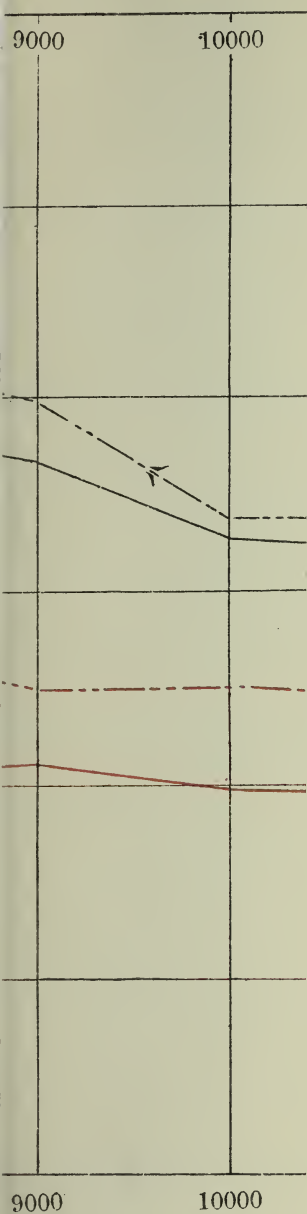
Acknowledgements.—Acknowledgements are here made to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs authorities, for daily observations and extra observations during typhoon weather, to the Telegraph Companies for transmitting the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties.

T. F. CLAXTON,

1925, February 20.

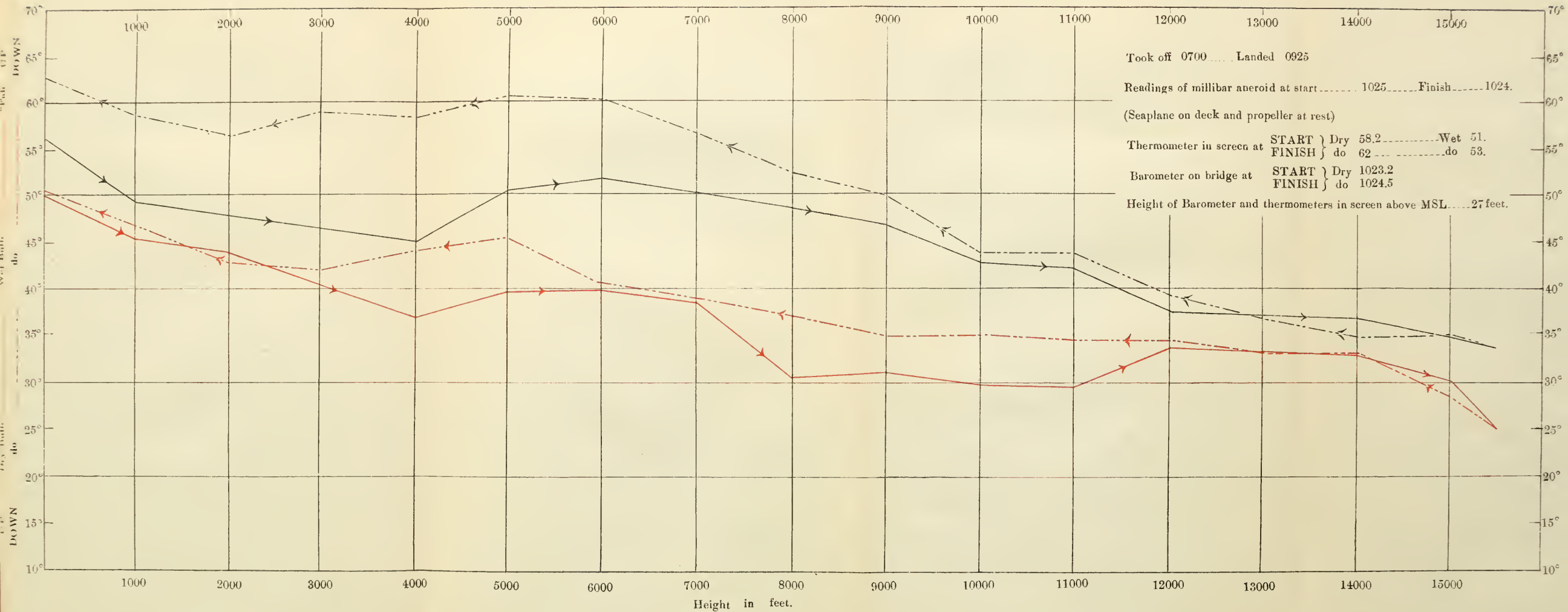
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IT AT HONGKONG

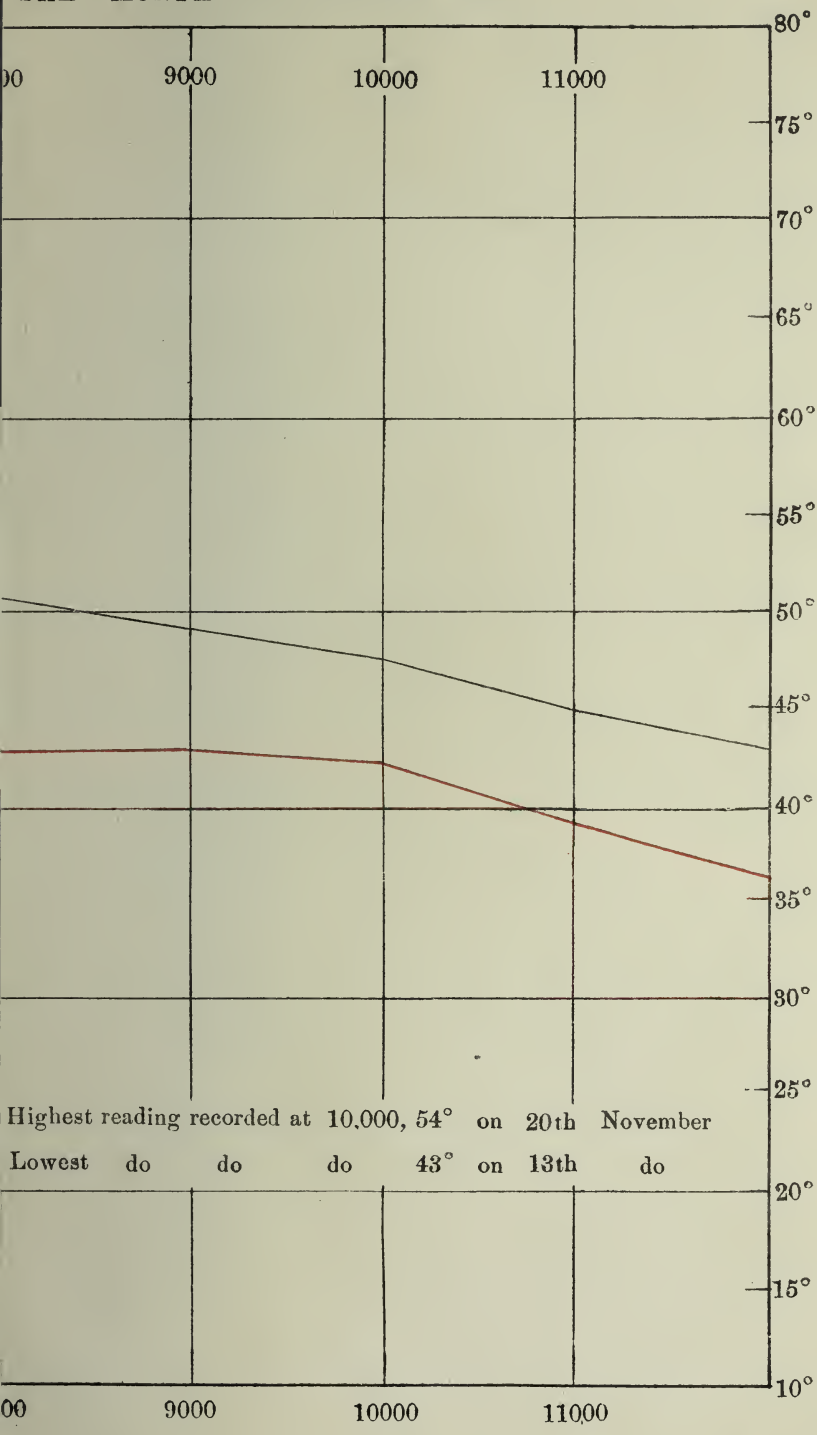


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WET AND DRY BULB READINGS TAKEN DURING RESEARCH FLIGHT AT HONGKONG ON 26TH NOVEMBER, 1924.



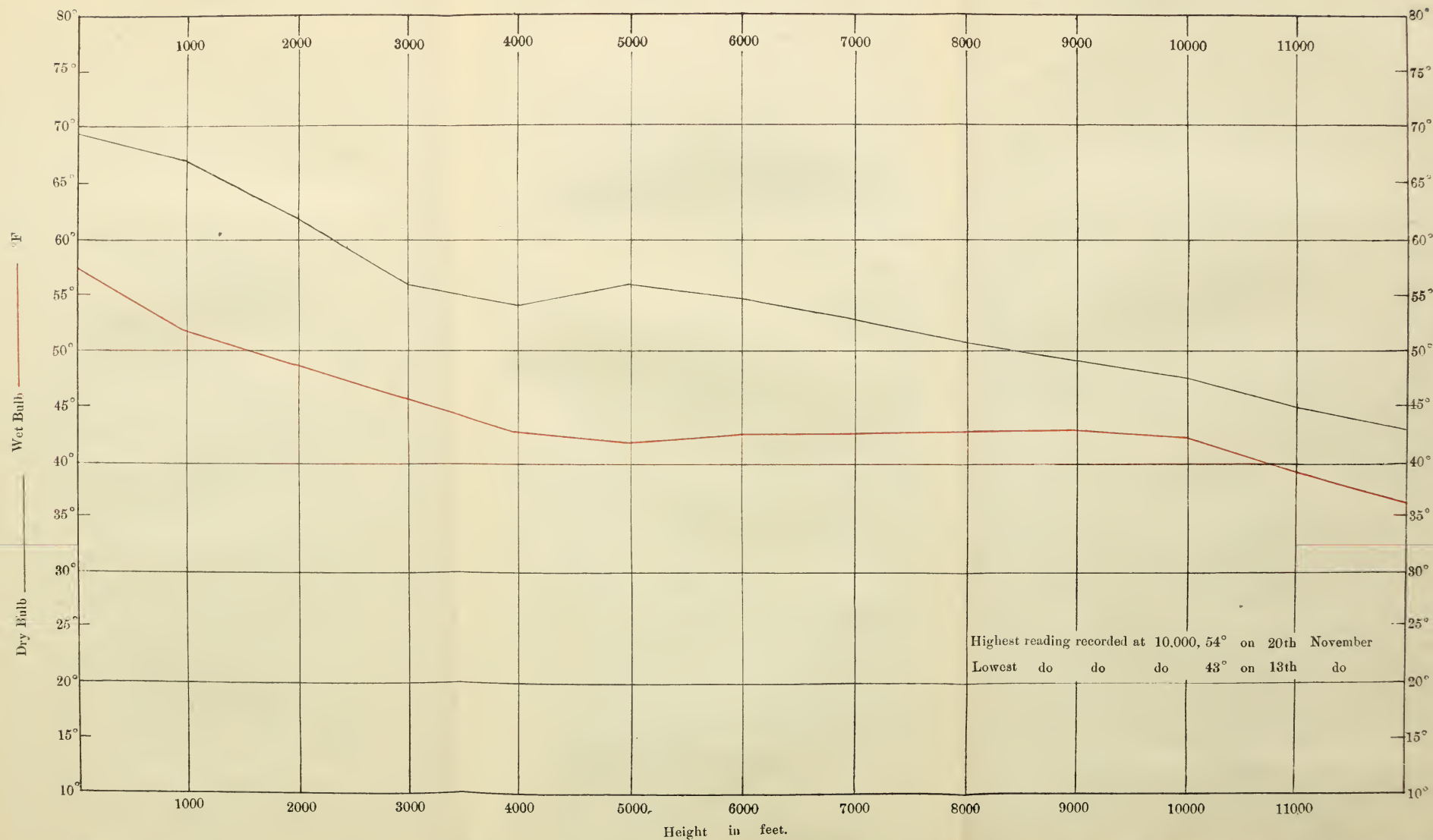
THE MONTH OF NOVEMBER 1924.



Highest reading recorded at 10,000, 54° on 20th November

Lowest do do do 43° on 13th do

MEANS OF TEMPERATURE READINGS TAKEN DURING FLIGHTS OVER HONGKONG IN THE MONTH OF NOVEMBER 1924.



REPORT OF THE DIRECTOR OF THE ROYAL OBSERVATORY, HONGKONG, FOR THE YEAR 1925.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

Underground Chamber for Seismograph and Clocks.—The diurnal inequality of temperature in the underground chamber is negligible and the change in 24 hours seldom exceeds 0°·3 F. The annual range amounted to 11°·3 (F) in 1924 and 11°·9 (F) in 1925. Changes of humidity are at times considerable; as, for example, from November 12*d* 17*h* to 13*d* 16*h* when the relative humidity decreased from 77% to 43% in response to a fall in the open air from 90% at 12*d* 15*h* to 38% at 13*d* 4*h*.

In the following table the mean monthly temperature and humidity in the Underground Chamber are compared with the temperature and humidity in the open air. As the air in the Underground Chamber is always still, humidity tables for calm air have been computed and used for obtaining the relative humidity from the readings of the dry and wet bulb thermometers.

Mean Monthly Temperature and Relative Humidity in the Underground Chamber and in the Open Air, during the year 1925.

Month 1925.	In Underground Chamber.		In Open Air.		Excess of Under- ground Chamber over Open Air.	
	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity
	°	%	°	%	°	%
January, ...	71·6	65	56·8	76	+ 14·8	— 11
February,...	69·3	54	56·0	70	+ 13·3	— 16
March,.....	68·9	72	63·7	81	+ 5·2	— 9
April,	69·1	77	65·2	83	+ 3·9	— 6
May,	72·9	95	77·4	85	— 4·5	+ 10
June,	76·4	96	81·1	82	— 4·7	+ 14
July,.....	79·0	98	82·5	81	— 3·5	+ 17
August, ...	80·0	94	82·5	79	— 2·5	+ 15
September,.	80·2	85	81·4	74	— 1·2	+ 11
October, ...	79·1	66	75·4	64	+ 3·7	+ 2
November,..	77·6	65	71·9	70	+ 5·7	— 5
December,..	74·5	47	62·9	58	+ 11·6	— 11
Range.....	11·3	51	26·5	27	...	...

It will be seen that while the annual range of temperature in the Underground Chamber is less than half the range in the open air, the range of humidity is nearly double. Unfortunately, the humidity in the Underground Chamber is highest in the summer months and to reduce it by raising the temperature is expensive ; moreover the amount by which the temperature must be raised to reduce the relative humidity to even 70 % is excessive ; about 11° in 1925. This would produce a very unpleasant atmosphere in the room. For these reasons no attempt has been made to keep the humidity within reasonable bounds.

II.—METEOROLOGICAL INSTRUMENTS.

Barometers.—The Marvin compensated syphon barometer has worked satisfactorily.

The station barometer No. 1323 and the large Casella barometer were compared with the Observatory Standard on December 2nd and 28th.

Beckley Anemograph.—This instrument was oiled and the orientation of the vane checked once a month.

Dines-Baxendell Anemograph.—The bearings of the vane were oiled and its orientation checked once a month. The spindle of the float was cleaned and oiled once a week.

The Mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1924 are given in the following table, together with the results for 1925 :—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor (Dines \div $\frac{\text{Beckley}}{3}$).	
	Mean 1910-1924.	1925.
January,	1'94	1'92
February,	1'98	1'88
March,	2'03	2'04
April,	2'05	2'11
May,	2'31	2'41
June,	2'23	2'50
July,	2'36	2'79
August,	2'30	3'08
September,	2'29	3'25
October,	2'21	3'06
November,	2'11	2'64
December,	2'05	2'06
Year	2'13	2'14

Thermometers.—All thermometers in use are compared with Kew Standard No. 647 in winter and summer.

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell Anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura pluviograph and the amount of sunshine by two Campbell-Stokes universal sunshine recorders. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hongkong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal features of the Weather.—The principal features of the weather in 1925 were:—

(a) Heavy rain in June and July.

(b) Temperature considerably below normal from April 4 to 18.

Barometric pressure was considerably above normal in April, October and December. It was considerably below normal in January, and moderately below in March, May and August. The mean pressure for the year at station level was $29\cdot845^{\text{ins.}}$ as against $29\cdot830^{\text{ins.}}$ in 1924 and $29\cdot842^{\text{ins.}}$ for the past 42 years. The highest pressure was $30\cdot343^{\text{ins.}}$ on December 30 as against $30\cdot314^{\text{ins.}}$ in 1924 and $30\cdot509^{\text{ins.}}$ for the past 42 years. The lowest pressure was $29\cdot272^{\text{ins.}}$ on July 14 as against $29\cdot365^{\text{ins.}}$ in 1924, and $28\cdot590^{\text{ins.}}$ for the past 42 years.

The temperature of the air was considerably below normal in April and moderately below in January and February. It was moderately above normal in November. The mean temperature for the year was $71^{\circ}\cdot4$ as against $72^{\circ}\cdot3$ in 1924 and $71^{\circ}\cdot9$ for the past 42 years. The highest temperature was $92^{\circ}\cdot8$ on August 28, as against $93^{\circ}\cdot2$ in 1924 and $97^{\circ}\cdot0$ for the past 42 years. The lowest temperature was $39^{\circ}\cdot7$ on February 1 as against $47^{\circ}\cdot5$ in 1924 and $32^{\circ}\cdot0$ for the past 42 years. The mean temperature for April, $65^{\circ}\cdot2$, was the lowest on record.

The rainfall was considerably above normal in March, June, and July and considerably below in May and August. The total for the year was $87\cdot58^{\text{ins.}}$ as against $98\cdot57^{\text{ins.}}$ in 1924 and $85\cdot19^{\text{ins.}}$ for the past 42 years. The greatest fall in one civil day was $10\cdot38^{\text{ins.}}$ on July 17 as against $20\cdot495^{\text{ins.}}$ for the past 42 years, and the greatest in one hour was $3\cdot16^{\text{ins.}}$ between 10.30 p.m. and 11.30 p.m. on June 15 as against $3\cdot480^{\text{ins.}}$ for the past 42 years.

The wind velocity was slightly above normal in March and moderately below normal in January, July, September and October. The mean velocity for the year was 11.5 m.p.h. as against 11.7 m.p.h. in 1924 and 12.6 m.p.h. for the past 42 years. The maximum velocity for one hour, as recorded by the Beckley Anemograph, was 45 miles at 9 a.m. on June 26 as against 46 miles in 1924 and 108 miles for the past 42 years. The maximum squall velocity, as recorded by the Dines-Baxendell Anemograph, was at the rate of 65 m.p.h. at 7.7 p.m. on July 15 as against 130 m.p.h. for the past 16 years.

Rainfall at four Stations.—In the following table the monthly rainfall for the year 1925 at the Observatory is compared with the fall at the Police Station, Tai Po; the Botanical Gardens; and the Matilda Hospital, Mount Kellet :—

Month.	Observatory (<i>Kowloon</i>).	Police Station (<i>Tai-po</i>).	Botanical Gardens (<i>Hongkong</i>).	Matilda Hospital (<i>Hongkong</i>).
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	4'335	3'57	4'90	4'60
February, ...	0'385	0'56	0'43	0'42
March,	8'280	5'49	8'38	8'03
April,	7'935	9'30	8'20	7'97
May,	2'580	2'33	3'28	4'80
June,	23'355	21'17	24'74	21'11
July,	20'665	26'42	23'13	21'12
August,	5'625	6'34	6'95	5'68
September,...	9'940	5'50	10'04	5'25
October,	3'165	3'51	3'76	2'30
November, ...	1'090	1'04	1'19	1'26
December, ...	0.225	0'26	0'29	0'38
Year....	87'580	85'49	95'29	82'92

Floods.—The heaviest rainfall occurred at the Observatory as follows :—

<i>Period.</i>				<i>Amount.</i> inches.	<i>Duration.</i> hours.	<i>Greatest fall in 1 hour.</i>	
						<i>Amount.</i> inches.	<i>Time.</i> d. h.
d.	h.	d.	h.				
March 26	7 to	Mar. 27	16	3'30	29	0'79	March 26 22
April... 1	1 to	April 1	21	3'10	12	1'20	April 1 16
June ...14	3 to	June 17	17	14'53	41	3'16	June 15 23
July ...14	15 to	July 19	5	17'11	42	2'88	July 17 7
Sept...18	5 to	Sept. 19	4	5'12	7	3'12	Sept. 19 1

Serious floods and landslides were caused by the heavy rains in March, June and July.

Typhoons.—The tracks of 13 typhoons and 26 of the principal depressions which occurred in the Far East, in 1925, are given in two plates in the Monthly Meteorological Bulletin for December, 1925.

Winds of typhoon force were not experienced at Hongkong in 1925. On June 26 however a typhoon passed about 100 miles S.W. of the Colony on a north-westerly track, causing an E.S.E. gale at Hongkong. The greatest squall velocity, as recorded by the Dines-Baxendell Anemograph was at the rate of 60 m.p.h. at 9.40 a.m. During another typhoon, which passed a little to the N.E. and N. of Swatow on July 15, on a north-westerly track, Hongkong experienced a squall at the rate of 65 m.p.h. at 7h. 7m. p.m., the highest recorded during the year; though the maximum wind velocity for one hour during this storm was only 35 m.p.h., at 4 p.m. on July 15.

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East, for 6 a.m. of the 120th Meridian time, is constructed daily and lithographed at the Observatory. On the verso is printed the morning weather report, from about 40 stations in China, Indo-China, Japan, Borneo and the Philippines, and a weather forecast for the following districts.

1. Formosa Channel.
2. S.E. Coast of China between Hongkong and Lamocks.
3. Hoagkong to Gap Rock.
4. S. Coast of China between Hongkong and Hainan.

This publication is exhibited on notice boards at the Hongkong and Kowloon Ferry Piers, the Harbour Office and at the offices of the cable companies. It is also distributed to subscribers to the "Daily Bulletin". One copy is sent daily to the Institute of Engineers and Shipbuilders, one to the Director of the Meteorological Observatory, Macao, one to the Diocesan Boys' School and one to the Central British School, Kowloon. Copies are sent weekly to the Hydrographic Office, Bangkok.

The morning weather report and forecast is telegraphed to the Cape D'Aguilar Wireless Station in time for broadcasting at 1 p.m. It is broadcast again at 5 p.m.

A weather map for 2 p.m. of the 120th meridian time is also constructed daily but is not published. An afternoon weather report and forecast was printed and distributed locally until September 12th, when from motives of economy it was not printed but telegraphed to the Post Office for transmission to the morning papers. It is also telegraphed to Cape D'Aguilar for broadcasting at 8 p.m. and midnight.

Monthly Meteorological Bulletin.—The monthly Meteorological Bulletin, which includes the Daily Weather Report, was published as usual, and distributed to the principal observatories and scientific institutions in different parts of the world.

Monthly Weather Maps.—Weather maps showing the mean monthly atmospheric pressure and wind direction and force over the China Sea were published at the end of the year and distributed to the principal observatories in different parts of the world. A small supply is available for shipmasters, who may obtain them free of charge on application to the Director. A small supply is also available for the public at \$3 each. These maps, which were drawn by Messrs. Jeffries and Evans and lithographed at the Observatory, were constructed from data collected during the years 1890-1912 and reduced by the Observatory Staff.

The effect of the islands of Formosa, Luzon and Hainan on the pressure distribution is very marked. A V-shaped depression is shown over the S.W. coast of Formosa and a wedge over the N.E. coast, except in the summer months, when the gradients over the island are relatively shallow and the trend of the isobars uncertain. In June and July the conditions are reversed, the wedge appearing over the S.W. coast and the V over the N.E. coast. In August and September there appears to be a low over the N.E. coast.

A very remarkable V-shaped depression is shown over the west coast of Luzon in the winter months, but in the summer months the trend of the isobars is uncertain, particularly in August. As regards the effect of the Island of Hainan, in the winter months there is a tendency for the isobars to encircle the island, but a large number of accurate observations are required to trace the effect in the summer months. The trend of the isobars farther south than latitude 10° N. is uncertain in every month, but the absolute values are sufficiently accurate for the sailor.

Monthly Seismological Bulletin.—The publication of a monthly seismological bulletin, giving particulars of earthquakes recorded by the Milne-Shaw seismograph, was continued throughout the year, and distributed to the principal seismological Observatories.

Miscellaneous Returns.—A monthly abstract of observations made at the Observatory is published in the Government Gazette, and monthly and yearly results are published in the Blue Book in the form suggested by the London Meteorological Office for the British Colonies. The monthly departures from normal of the barometric pressure at four China-Coast Ports are communicated to the Commonwealth Meteorologist, Melbourne, in connection with long range weather forecasts. Monthly Meteorological returns are forwarded to the Meteorological Magazine, and annual returns to the Stock Exchange Official Intelligence, the Colonial Office List and Whitaker's Almanack. Particulars of the calendar, eclipses, times of sunrise and sunset &c. are communicated to the "Directory and Chronicle" and the "Hongkong Dollar Directory".

V.—WEATHER TELEGRAMS, FORECASTS AND STORM WARNINGS.

Daily Weather Telegrams.—In addition to the ordinary 6 a.m. and 2 p.m. observations those for 11 a.m. and 5 p.m. are now received from the following stations:—

Shanghai	Macao	Cape St. James.
Phulien	Tourane	

Similar observations from Gutzlaff and Amoy have been sanctioned but have not yet been received.

By the courtesy of the Naval Commander-in-Chief arrangements were made at the close of the year for all cruisers, submarine depot ships and sloops on the China station, whilst away from Hongkong, at sea or in harbour, to make meteorological observations at 6 a.m., 11 a.m., 2 p.m., and 5 p.m., Hongkong Standard Time, and transmit them to Hongkong; also for gunboats on the Yangtze and West River to make and transmit observations at 6 a.m. daily.

This service has started and forms a very valuable addition to the observations received by cable and from ships of the mercantile marine.

Another valuable addition has been the Japanese Observatory in the Pelew Islands (latitude 7.20 N. and longitude 134.29 E.) from which the 6 a.m. observations have been received regularly by wireless telegraphy since November 12.

The much needed wireless station on the Pratas Shoal (latitude 20.40 N. and longitude 116.47 E.) after negotiations extending over 16 years, was completed in August, and 6 a.m. observations have been received regularly, since August 15, except from November 4 to November 23 when, apparently, the station was out of commission. Since August 21 the 2 p.m. observations have also been received.

The wireless installation at Yap was wrecked by a typhoon on December 15, and no observations were received from this date until January 26.

Occasionally belated weather telegrams are received from South China, but as a rule the observations from these districts are posted in batches to Hongkong, as are those from Central China.

Extra Weather Telegrams.—the following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hongkong:—Amoy, Canton, Macao, Phulien, Sharp Peak and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The extra 9 p.m. telegram from Swatow, kindly sanctioned by the Chinese Telegraph Administration during the typhoon season, was not received in 1925.

Weather Telegrams by Radio.—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately) :—

Month.	British (including H.M. Ships).		Other National- ities.		Total		
	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.	
January,	77	227	57	105	134	332	
February,	58	210	57	130	115	340	
March,	66	210	58	110	124	320	
April,.....	56	188	62	165	118	353	
May,	51	149	64	141	115	290	
June,.....	68	202	78	150	146	352	
July,	52	136	50	119	102	255	
August,.....	59	151	105	224	164	375	
September,	52	176	56	148	108	324	
October,.....	52	187	66	202	118	389	
November,.....	46	180	42	110	88	290	
December,.....	50	183	57	158	107	341	
Totals {	1925,	687	2199	752	1762	1439	3961
	1924,	665	1703	852	1667	1517	3370
	1923,	196	409	431	698	627	1107
	1922,	280	732	369	702	649	1434
	1921,	121	267	145	238	266	505

It will be seen that while the total number of British ships co-operating increased slightly, the number of ships of other nationalities decreased from 852 in 1924 to 752 in 1925. This is disappointing and difficult to explain. A Notice to Mariners giving particulars of what information is required is handed to masters of vessels by the Harbour Department. Copies are also sent to the shipping companies for distribution to their Captains and supplies are sent to the Master Attendant, Singapore, who has kindly consented to furnish copies to north bound ships. A form for standardizing the returns has been drawn up in co-operation with the observatories at Manila and Zikawei and

placed on board all vessels provided with wireless installations ; but this has not given the impetus which was anticipated.

Results of Weather Forecasts.—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, with the results of the previous five years :—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1920	64	30	5	1
1921	65	30	5	0
1922	67	30	3	0
1923	66	30	3	1
1924	71	24	5	0
1925	62	34	4	0

The forecast comprises wind direction, wind force, and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings.—The symbols of the China Seas Storm Signal Code are displayed on Kowloon Signal Hill.

The following Ports are warned by a telegraphic adaptation of the code :—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phulien, Taihoku, Manila, Labuan, and Singapore. 94 storm warnings were sent in 1925. 119 were received from Manila and 61 from Zikawei, 8 were received from Phulien, via Quang Chau Wan Radio Station. The corresponding numbers in 1924 were 194, 186, 65 and 14, respectively.

At the request of the Director General of Indian Observatories arrangements were made with Eastern Extension Telegraph Co. to send warnings to Simla of any typhoon passing westward over Indo-China. Only one such warning was necessary during the year ; namely, on November 11.

The Day Signals of the Local Code are displayed at the following stations :—

Royal Observatory	Green Island
H. M. S. Tamar	Hongkong and Kowloon,
Gough Hill	Wharf and Godown Co.,
Standard Oil Co.,	Kowloon.
Lai-Chi-Kok	Field Officer's Quarters,
Harbour Office	Lyemun.

The Night Signals are displayed, at sunset, at the following stations :—

Royal Observatory	H. M. S. Tamar
Harbour Office	Gough Hill
Railway Station	

They have the same signification as the day signals.

A translation of both Day and Night Signals is displayed at the General Post Office and at the Upper Tram Station.

When local signals are displayed in the Harbour a Cone is exhibited at the following stations :—

Gap Rock	Stanley	Sau Ki Wan	Sha Tan Kok
Waglan	Aberdeen	Sai Kung	Tai Po

In the following table is given the number of hours the local signal were hoisted in each of the years 1921-1925 : —

Year.	Red Signals.	Black Signals.	Bombs.
	Number of hours hoisted.		Number of times fired.
1921	94	121	...
1922	181	154	...
1923	181	252	2
1924	186	85	...
1925	128	57	...

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signal indicates that a depression exists which may possibly cause a gale at Hongkong within 24 hours. The black signals indicate that a gale is expected at Hongkong.

Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &C.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 158 ships operating in the Far East. These logs, representing 6,697 days' observations have been utilised for amplifying the weather maps and verifying typhoon tracks. The corresponding figures for the year 1924 were 190 and 7,222.

Comparison of Barometers.—The corrections to ships' barometers are usually obtained by comparing their readings while at Hongkong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

VII.—MAGNETIC OBSERVATIONS.

Magnetic horizontal force, declination, and dip are observed once a month. In the dip observations 4 needles are used in rotation, the result for each month being the mean of determinations with two needles.

In the following table are given the annual values of the magnetic elements in 1925 as derived from observations made in the new magnetic hut with magnetometer Elliott 83 and dip circle Dover 71 :—

Declination (West).....	0.27.2
Dip (North).....	30.41.8
Horizontal Force (C. G. S. unit)	0.37325
Vertical Force (C. G. S. unit)	0.22159
Total Force (C. G. S. unit)	0.43408

A site for a new magnetic observatory was selected in the vicinity of the Au Tau Police Station, approximately 14 miles north-west from the Royal Observatory (30 miles by road). It is situated in the midst of extensive rice cultivation, and would appear to be reasonably safe-guarded from future building encroachments. The erection of the necessary buildings has been postponed on account of the existing financial depression.

VIII.—TIME SERVICE.

Time Ball.—The Time Ball on Kowloon Signal Hill is dropped at 10 a.m. and 4 p.m., daily, except on Saturdays when it is dropped at 10 a.m. and 1 p.m., and on Sundays and Holidays when it is dropped at 10 a.m. only (120th Meridian Time).

The Ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

Time Signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. The lights are extinguished momentarily every second from 8h. 55m. to 9h. 0m. p.m., except at the 28th, 29th, 54th, 55th, 56th, 57th, 58th and 59th seconds, of each minute. The 9 p.m. signals were repeated at midnight on December 31st, the last signal indicating the close of the year 1925. The hours refer to Hongkong Standard Time (8 hours East of Greenwich).

The Time Ball was dropped successfully 664 times. There was one failure, on December 16th at 10 a.m., owing to an injury sustained by the coolie, when hoisting the ball. It was dropped successfully at 11 h. The ball was not raised on June 26th at 10 h a.m. owing to high wind, and on July 14th at 4 p.m., during a severe thunderstorm.

In the following table is given the number of times different errors occurred in the year 1924 and 1925.

Error of Time Ball.	Number of Times.	
	1924	1925
0·3 sec. or less	530	631
0·4 "	44	12
0·5 "	37	8
0·6 "	23	5
0·7 "	10	3
0·8 "	5	...
0·9 "	...	2

Errors of 1.2, 1.9 and 2.0 seconds respectively occurred on one occasion. All errors in excess of 0.7 second occurred during the period January 16 to 22 when the rates of the sidereal clocks were seriously disturbed by workmen. No error greater than 0.4 has occurred since March 27th.

The mean probable error of the time ball in each month for the past five years is given in the following table:—

Month.	Probable Error of the Time Ball.				
	1921	1922	1923	1924	1925
January,	±0·25	±0·10	±0·16	±0·26	±0·38
February,	·13	·15	·14	·13	·22
March,	·44	·12	·11	·17	·22
April,	·27	·20	·18	·27	·16
May,	·16	·10	·13	·23	·11
June,	·17	·11	·21	·27	·10
July,	·10	·14	·12	·21	·10
August,	·10	·10	·28	·16	·12
September,	·20	·15	·24	·13	·10
October,	·10	·10	·15	·18	·12
November,	·10	·17	·21	·14	·10
December,	·11	·10	·13	·12	·10
Means,	±0·18	±0·13	±0·17	±0·19	±0·15

Time Signals by Radio-Telegraphy.—In addition to the time signals given by the Time Ball, and on the radio mast, signals are broadcast at 10^h and 21^h by radio telegraphy via Stonecutters. Particulars of the programme are given in Government Notifications No. 359 of 13.6.24 and No. 637 of 14.11.24.

The following table gives particulars of the time-signals received by radio telegraphy during the year.

Station.	Time of Emission.	No. of observations.	Mean difference. (H.K. slow.)
	<i>h</i>		<i>s</i>
Pearl Harbour	8 a.m.	101	0.79
* Nauen	8 a.m.	84	0.64
† Nauen	8 a.m.	135	0.64
Malabar	9 a.m.	172	0.59
Funabashi	{ 10 a.m. 8 p.m.	{ 101	0.59
Manila	11 a.m.	150	0.84
* Bordeaux	4 p.m.	37	0.30

* International Code.

† Rhythmic Signals.

Simultaneous observations of the Bordeaux rhythmic Time Signals by radio were made by the Royal Observatory, Greenwich, and this Observatory on 13 occasions, between September 3rd and November 1st, 1924. A comparison of the adopted times of receipt at Greenwich and Hongkong has been made possible by the courtesy of the Astronomer Royal, and the longitude as redetermined by this means is *7h 36m 41.25s* (East of Greenwich). This value will be used from January 1st, 1926, in place of *7h 36m 41.86s* determined by Commander Green of the U. S. Navy in 1881.

Transit Instrument.—Routine transit and level observations were made by the Chinese computers throughout the year. The Collimation and Azimuth determinations and occasional transit observations were made by the Chief and First Assistants.

The number of observations in the years 1924 and 1925 was as follows :—

	1924.	1925.
Transits.....	1447	1375
Level determinations	864	702
Azimuth determinations	69	54
Collimation determinations.....	66	54

Clocks.—The performance of the Sidereal Clock, Dent 39741, has again been characterized by a steady increase in losing rate since April. It varied from $-0s.35$ on April 11th and 12th (Barometer $30in.05$ Temperature $60^{\circ}.8$) to $+1s.30$ on December 26th (Barometer $30in.08$ and temperature $66^{\circ}.1$).

Sidereal clock Cottingham and Mercer, No. 507, has been in use as the Observatory Standard since March 10.

The clock was adjusted on several occasions during the year and the contact springs cleaned on July 20. From November 11 to December 31 the clock was undisturbed and its daily losing rate varied from $+0s.04$ to $-0s.07$; the greater part of this variation is due to changes of pressure in the clock case brought about by changes of temperature in the room.

In the following table is given the excess of the observed error of the Sidereal Standard Clock over the computed error during cloudy periods in 1925 :—

Date 1925.		Interval without observations.	Excess of observed over computed error.
			<i>secs.</i>
January	9	8 days	— 0'42
"	19	8 "	+ 0'56
"	21	2 "	+ 0'90
"	29	3 "	+ 0'28
February	14	4 "	— 0'29
"	20	3 "	— 0'47
"	26	3 "	— 0'45
April	11	27 "	+ 0'26
"	17	3 "	— 0'11
"	25	2 "	+ 0'24
May	3	7 "	+ 0'16
"	6	2 "	+ 0'01
"	12	3 "	— 0'05
"	20	5 "	+ 0'20
"	26	2 "	— 0'16
June	18	3 "	+ 0'02
"	25	2 "	+ 0'08
July	19	5 "	— 0'13
August	13	3 "	— 0'19
September	2	4 "	+ 0'14
November	18	2 "	+ 0'06
"	21	2 "	+ 0'09
"	24	2 "	+ 0'09
December	20	4 "	— 0'02
"	25	2 "	— 0'02

The large errors of the clock on January 19-21 have already been alluded to under "Timeball"; otherwise a very considerable improvement has been effected in the Time Service generally, by

the installation of the Cottingham clock and the improved reception of radio time-signals. Apart from any intrinsic merits of the Cottingham escapement, the mounting of the clock under conditions of least change in pressure and temperature tends to produce steadier rates than has been possible with the Dent Sidereal hitherto.

The regular observation of the Nauen radio time signal at 8 a.m. has proved an invaluable check upon clock performance. The signal consistently maintains a high degree of accuracy, and, assuming regular reception, accumulated clock errors of any magnitude over cloudy periods are now unlikely. It is therefore of extreme importance that radio time signals of undoubted accuracy should continue to be regularly received here, as cloudy periods are occasionally of considerable length.

The Mean Time clock, Leroy 1350, was used for dropping the Time Ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10 a.m. and before 4 p.m. by the electric regulating apparatus. The daily rate of the pendulum is kept below 0.5 sec. by the addition or withdrawal of weights. Mean Time clock Dent, 39740, has been corrected daily and its rate regulated as in the case of Leroy 1350.

Chronometer Dent No. 40917 is on loan to Stonecutters Radio Station.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light and Power Co. Ltd., by the rotary converter or the Tungar rectifier; the latter having been returned by the P.W.D. early in the year.

IX.—MISCELLANEOUS.

Seismograph.—159 earthquakes were recorded during the year by the Milne-Shaw Seismograph, as against 149 in 1924. The seismograms have been forwarded to the President of the Seismological Committee, Oxford.

Upper Air Research.—40 flights with pilot balloons were made during the year. On September 25 the balloon was observed for 131 minutes, and on September 24 for 90 minutes. I imagine the former is one of the longest observed flights on record. The results of the observations have been sent to the Commission International pour l'exploration de la haute atmosphere, Oslo, (Kristiania).

Visitors.—30 students from St. Stephen's Girls' College visited the Observatory on April 14.

Staff.—No change occurred in the European or Local Staff during the year. Mr. C. W. Jeffries acted as Director of the Observatory during the absence on leave of Mr. T. F. Claxton from April 5 to November 11, and Mr. B. D. Evans acted as Chief Assistant.

The Strike.—On leaving the Observatory on June 26 the printer and his assistant were assaulted by intimidators, so failed to attend on June 27 and 28. In consequence the weather reports for these days were not issued until June 29 when the printers returned to duty. This was the only interruption caused by the strike, so far as the routine work of the Observatory was concerned.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows :—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1916	21,977.78	.....	1,255.34
1917	26,890.50	4,192.72	.....
1918	20,028.24	.....	6,862.26
1919	23,450.57	3,422.33	.....
1920	25,965.66	2,515.09	.....
1921	32,700.51	6,734.85	.....
1922	38,350.10	5,649.59	.....
1923	38,522.58	172.48	.....
1924	52,638.49	14,115.91	.....
1925	41,955.51	.....	10,682.98

Acknowledgements.—Acknowledgements are here made to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs authorities, for daily observations and extra observations during typhoon weather, to the Telegraph Companies for transmitting the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties.

T. F. CLAXTON,
Director.

18th February, 1926.

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REPORT OF THE DIRECTOR
OF THE ROYAL OBSERVATORY, HONG KONG,
FOR THE YEAR 1926.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

The wireless house was completed in November and the receiving set was removed from its temporary shelter in the old Telescope dome to the new house on November 30. This house is situated 51 yards to the south of the main building. It is a rectangular building 44 feet long by 18 feet wide, with brick walls 12 feet high at the eaves, and a gabled roof of Canton tiles. It contains an engine and battery room, 18 feet long by 12 feet wide, and a main instrument room 32 feet long by 18 feet wide. The Receiver is a Marconi "Press" type RP 2 B, with a wave range of 750 to 26,000 metres. The Transmitter is a Marconi type "Q", $1\frac{1}{2}$ Kw. with wave range of 250 to 1,000 metres. Frequency 300 cycles. The systems used are:—

Continuous wave.

Interrupted Continuous wave.

Telephone.

Underground Chamber for Seismograph and Clocks.—The diurnal inequality of temperature in the underground chamber is negligible and the change in 24 hours seldom exceeds $0^{\circ}.3$ F. The annual range amounted to $11^{\circ}.3$ (F) in 1925 and $9^{\circ}.1$ (F) in 1926. Changes of humidity are at times considerable; as, for example, from January 15d. 21h. to 16d. 13h. when the relative humidity decreased from 71% to 51%, from March 12d. 12h. to 13d. 2h. when it increased from 61% to 85%, from May 7d. 16h. to 8d. 9h., when it decreased from 90% to 65%, and from December 7d. 17h. to 8d. 12h. when it decreased from 75% to 55%. From June 22 to September 17 the humidity was never less than 93%.

In the following table the mean monthly temperature and humidity in the Underground Chamber are compared with the temperature and humidity in the open air. As the air in the Underground Chamber is always still, humidity tables for calm air have been computed and used for obtaining the relative humidity from the readings of the dry and wet bulb thermometers.

Mean Monthly Temperature and Relative Humidity in the Underground Chamber and in the Open Air, during the year 1926.

Month 1926.	In Underground Chamber.		In the Open Air.		Excess of Underground Chamber over Open Air.	
	Temperature	Relative Humidity	Temperature	Relative Humidity	Temperature	Relative Humidity
	°	%	°	%	°	%
January, ..	71·9	54	61·1	72	+ 10·8	— 18
February, ..	70·7	61	60·0	82	+ 10·7	— 21
March,	70·5	70	63·8	82	+ 6·7	— 12
April,	71·4	81	68·9	87	+ 2·5	— 6
May,	73·4	88	76·1	83	— 2·7	+ 5
June,	75·3	89	77·8	83	— 2·5	+ 6
July,	77·8	96	82·1	81	— 4·3	+ 15
August, ...	79·1	94	82·1	83	— 3·0	+ 11
September	79·6	92	81·5	80	— 1·9	+ 12
October, ..	78·0	74	74·5	74	+ 3·5	...
November, ..	75·9	71	68·9	73	+ 7·0	— 2
December, ..	73·5	66	62·7	69	+ 10·8	— 3
Range.....	9·1	42	22·1	18	...	...

II.—METEOROLOGICAL INSTRUMENTS.

Barometers.—The Marvin compensated syphon barometer has worked satisfactorily, except that the buzzer for overcoming inertia and friction, and the time-break apparatus, have failed occasionally. In the month of February, a combined buzzer and time-break apparatus was fitted by Mr. Evans.

The coils of an electric bell were screwed to the base plate near the suspension thread of the conical steel float and a one-inch nail inserted in the suspension thread at the same height as the coils. The minute signal circuit to the thermograph buzzer was lead through these coils, which therefore acted as a buzzer and vibrated the nail on the float suspension. The hourly signal was also lead through the coils thus attracting the nail and causing an appreciable mark on the register.

This scheme works well provided the battery strength remains fairly constant and the thermograph buzzer works well.

The station barometer No. 1323 and the large Casella barometer were compared with the Observatory Standard on April 30, and June 26.

Beckley Anemograph.—This instrument was oiled and the orientation of the vane checked once a month.

Dines-Baxendell Anemograph.—The bearings of the vane were oiled and its orientation checked once a month. The spindle of the float was cleaned and oiled once a week, but the instrument still works erratically at low wind velocities.

The Mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1925 are given in the following table, together with the results for 1926:—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor ($\text{Dines} \div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1925.	1926.
January,	1'94	1'94
February,	1'97	1'95
March,	2'03	1'89
April,	2'05	1'90
May,	2'17	2'03
June,	2'11	1'94
July,	2'24	2'15
August,	2'20	2'10
September,	2'21	2'36
October,	2'12	2'04
November,	2'01	1'76
December,	1'93	1'70
Year.....	2'08	1'98

Thermometers.—All thermometers in use are compared with Kew Standard No. 647 in winter and summer.

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell Anemograph, modified as described in the report of 1912. The amount of rain is recorded automatically by a Nakamura pluviograph and the amount of sunshine by two Campbell-Stokes universal sunshine recorders. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hong Kong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal features of the Weather.—The principal features of the weather in 1926 were:—

- (1) Phenomenal rainfall during a prolonged and very severe thunderstorm on July 19, when 21 inches of rain fell in 18 hours, causing severe floods and land slides.
- (2) Rainfall much above the average in April, July and September.
- (3) Typhoons which passed near Hong Kong on July 22 and September 27.
- (4) Heat waves in July, August and September, and relatively cold spells in April and June.

Barometric pressure was moderately above normal in January, February, March, and August. It was nearly normal in other months. The mean pressure for the year at station level was 29.857 ins. as against 29.845 ins. in 1925 and 29.843 ins. for the past 43 years. The highest pressure was 30.384 ins. on January 25, as against 30.343 ins. in 1925 and 30.509 ins. for the past 43 years. The lowest pressure was 29.229 ins. on July 22 as against 29.272 ins. in 1925, and 28.590 ins. for the past 43 years.

The temperature of the air was moderately above normal in January, February, March and September. It was considerably below normal in June, the mean value for the month, 77°.8, being the lowest on record; and moderately below in October, the mean value for the month, 74°.5, being the lowest on record except in 1911 and 1919 when it was 74°.3 and 74°.2 respectively. The mean temperature for the year was 71°.6 as against 71°.4 in 1925 and 71°.9 for the past 43 years. The highest temperature was 92°.5 on August 16, as against 92°.8 in 1925 and 97°.0 for the past 43 years. The lowest temperature was 43°.2 on December 26 as against 39°.7 in 1925 and 32°.0 for the past 43 years.

The rainfall was considerably above normal in April, July and September, and considerably below in May, June and August. The total rainfall for April, 17.16 ins., was the greatest on record, and the total fall for July, 29.79 ins., has been exceeded on only one occasion; in 1917 when it was 30.07 ins. The total for the year was 100.78 ins. as against 87.58 ins. in 1925 and 85.55 ins. for the past 43 years. The greatest fall in one civil day was 21.02 ins. on July 19, which is the highest on record for the past 43 years, and the greatest in one hour was 3.96 ins. between 3.30 a.m. and 4.30 a.m. on July 19, also the highest on record for the past 43 years.

The wind velocity was considerably above normal in June, moderately below in March and November, and slightly below in January, July, September, October and December. The mean velocity for the year was 12.2 m.p.h. as against 11.5 m.p.h. in 1925 and 12.6 m.p.h. for the past 43 years. The maximum velocity for one hour, as recorded by the Beckley Anemograph,

was 73 miles at 10 a.m. on September 27, as against 45 miles in 1925 and 108 miles for the past 43 years. The maximum squall velocity, as recorded by the Dines-Baxendell Anemograph, was at the rate of 101 m.p.h. at 8.51 a.m. on September 27, as against 65 m.p.h. on 1925 and 130 m.p.h. for the past 17 years.

The relative humidity was moderately above normal in February and November, slightly above in April, September and October, and nearly normal in the other months. The mean relative humidity for the year was 79% as against 75% in 1925 and 77% for the past 43 years. It frequently exceeded 95% and the lowest for the year was 17% at 2 p.m. on December 27.

Rainfall at four Stations.—In the following table the monthly rainfall for the year 1926 at the Observatory is compared with the fall at the Police Station, Tai Po; the Botanical Gardens; and the Matilda Hospital, Mount Kellet:—

Month.	Observatory (Kowloon).	Police Station (Taipo).	Botanical Gardens (Hong Kong).	Matilda Hospital (Hong Kong)
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	0.215	0.00	0.31	0.35
February, ...	2.400	1.82	2.58	2.40
March,	4.840	3.44	5.03	4.68
April,	17.165	12.87	18.90	19.62
May,	5.730	9.02	5.84	3.70
June,	6.635	7.28	7.68	4.10
July,	29.790	23.25	20.84	22.53
August,	8.010	8.45	9.15	8.03
September,...	17.300	11.78	17.82	15.12
October,	3.275	4.86	3.44	2.84
November, ...	4.965	4.86	5.02	4.70
December, ...	0.455	0.00	0.16	0.16
Year....	100.780	87.63	96.77	88.23

Floods.—The heaviest rainfall occurred at the Observatory as follows:—

Period.				Amount.	Duration.	Greatest fall in 1 hour.			
d.	h.	d.	h.	inches.	hours.	Amount.	Time.	d.	h.
April...10	1	to April 16	4	10.96	71	2.225	April 10	10	13
July ...19	0	to July 19	14	20.83	14	3.965	July 19	4	4
July ...22	4	to July 23	0	3.72	19	0.506	July 22	22	22
Sept...21	0	to Sept. 21	17	5.61	14	1.880	Sept. 21	14	14

The rain on July 19 caused very severe floods and land slides.

Typhoons.—The tracks of 12 typhoons and 30 of the principal depressions which occurred in the Far East, in 1926, are given in two plates in the Monthly Meteorological Bulletin for December, 1926.

On the morning of July 22 a typhoon passed a few miles to the south of Gap Rock on a WNW track. Winds of force 10 were experienced at Gap Rock at 10*h* and 11*h* and squalls at the rate of 80 to 85 m.p.h. were recorded at the Observatory between 8*h.* and 9*h.* A typhoon also passed near Gap Rock on September 27, travelling at the rate of 24 m.p.h. Winds of force 12 were experienced at Gap Rock at 10*h* and 11*h*, and squalls at the rate of 90 to 101 m.p.h. were recorded at the Observatory between 7*h* and 9*h*. In the first typhoon the lowest barometer reading at the Observatory, reduced to sea level, was 29.33 ins., at 8*h.* 45*m.* In the second typhoon it was 29.29 ins. at 7*h.* 15*m.*

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East, for 6 a.m. of the 120th Meridian time, is constructed daily and lithographed at the Observatory. On the verso is printed the morning weather report, from about 40 stations in China, Indo-China, Japan, Borneo and the Philippines, and a weather forecast for the following districts:—

1. Formosa Channel.
2. S. E. Coast of China between Hong Kong and Lamooks.
3. Hong Kong to Gap Rock.
4. S. Coast of China between Hong Kong and Hainan.

This publication is exhibited on notice boards at the Hong Kong and Kowloon Ferry Piers, the Harbour Office and at the offices of the cable companies. It is also distributed to subscribers to the "Daily Bulletin". One copy is sent daily to the Institute of Engineers and Shipbuilders, to the Director of the Meteorological Observatory, Macao, to the Diocesan Boys' School, the Central British School, Kowloon, and to H.M.S. *Hermes* when at Hong Kong. Copies are sent weekly to the Hydrographic Office, Bangkok.

Since July 1, meteorological observations from 26 stations in the Far East have been broadcast by Cape d'Aguilar (V.P.S.) on a 600 metre spark at 0400 and 1200 G.M.T. and repeated on 2800 metres C.W. at 0500 and 1300, respectively. These messages are followed immediately by the weather reports and forecasts which were formerly broadcast at 0500 and 1200 G.M.T. The names of the observing stations included in the morning and evening broadcast, together with the hours at which the observations are taken at each station are given in Government Notifications 308 of 1926, May 28, and 428 of 1926, August 6.

A weather map for 2 p.m. of the 120th meridian time is also constructed daily. It is not published but an evening weather report and forecast is telephoned to the morning papers and exhibited on the notice boards.

Monthly Meteorological Bulletin.—The monthly Meteorological Bulletin, which includes the Daily Weather Report, was published as usual, and distributed to the principal observatories and scientific institutions in different parts of the world.

Monthly Seismological Bulletin.—The publication of a monthly seismological bulletin, giving particulars of earthquakes recorded by the Milne-Shaw seismograph, was continued throughout the year and distributed to the principal seismological Observatories.

Miscellaneous Returns.—A monthly abstract of observations made at the Observatory is published in the Government Gazette, and monthly and yearly results are published in the Blue Book in the form suggested by the London Meteorological Office for the British Colonies. The monthly departures from normal of the barometric pressure at four China-Coast Ports are communicated to the Commonwealth Meteorologist, Melbourne, in connection with long range weather forecasts. Monthly Meteorological returns are forwarded to the Meteorological Magazine, and annual returns to the Stock Exchange Official Intelligence, the Colonial Office List and Whitaker's Almanack. Particulars of the calendar, eclipses, times of sunrise and sunset, &c., are communicated to the "Directory and Chronical" and the "Hong Kong Dollar Directory."

V.—WEATHER TELEGRAMS, FORECASTS AND STORM WARNINGS.

Daily Weather Telegrams.—In addition to the ordinary 6 a.m. and 2 p.m. observations those for 11 a.m. and 5 p.m. are now received from the following stations:—

Shanghai	Macao	Cape St. James.
Phulien	Tourane	

Additional observations at 11 a.m. have been received from Gutzlaff since December 1, 1925, and from Amoy since December 2, 1926. Those for 5 p.m. have been received from Gutzlaff since March 10, 1926 and from Amoy since January 1, 1927. Those for 11 a.m. and 5 p.m. have been received from Yunanfu since September 16.

By the courtesy of the Naval Commander-in-Chief arrangements were made at the close of the year 1925, for all cruisers, submarine depot ships and sloops on the China station, whilst

away from Hong Kong, at sea or in harbour, to make meteorological observations at 6 a.m., 11 a.m., 2 p.m. and 5 p.m., Hong Kong Standard Time, and transmit them to Hong Kong; also for gunboats on the Yangtze and West River to make and transmit observations at 6 a.m. daily.

This service forms a very valuable addition to the observations received by cable and from ships of the mercantile marine.

On February 8, Mr. C.W. Hsu, the officer in charge of the Pratas Radio and meteorological station, brought two meteorological observers for Pratas to view the Observatory. Observations at 6h. and 14h. (120th meridian time) have been received by radio telegraphy from this station, on a 600 metre wave, with commendable regularity, and also at 11h and 17h since April 16. During typhoon weather Mr. Hsu very kindly sent us hourly observations, which were of very great value in connection with storm warnings.

On July 26 the station was formally opened by Admiral Hsu. The Director was unable to be present as the Chief Assistant was on leave and the acting Chief Assistant was in Hospital.

Occasionally belated weather telegrams are received from South China but as a rule the observations from these districts are posted in batches to Hong Kong, as are those from Central China.

In January the Japanese Authorities agreed to use the Hong Kong 6-letter code for the daily weather telegrams. Its use was sanctioned by the Cable Companies in 1915 and the sanction ratified in September, 1926. Owing, however, to the absence in Europe of Dr. Okada, the Director of the Tokio Observatory, the details of the scheme have not yet been settled.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hong Kong:—Amoy, Canton, Macao, Phulien, Sharp Peak and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The 9 p.m. observations from Swatow, kindly sanctioned by the Chinese Telegraph Administration, were occasionally received the same evening, but usually on the next or following day.

In September, Dr. S. Teramoto, director of the Taihoku Observatory, very kindly consented to send extra weather telegrams from the two stations in Formosa nearest to the typhoon centre, instead of from only one station.

Weather Telegrams from Ships by Radio.—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately):—

Month.	British (including H.M. Ships).		Other National- ities.		Total.		
	No. of ships.	No. of messages.	No. of ships.	No. of messages.	No. of ships.	No. of messages.	
January,	67	586	55	158	122	744	
February,	74	638	53	161	127	799	
March,	91	667	54	172	145	839	
April,.....	82	474	45	134	127	608	
May,	73	374	45	136	118	510	
June,.....	72	509	68	195	140	704	
July,	97	288	97	230	194	757	
August,.....	116	378	91	258	207	859	
September,	98	275	64	205	162	652	
October,.....	116	444	96	266	212	926	
November,.....	90	340	77	228	167	779	
December,.....	82	243	86	233	168	706	
Totals {	1926,	1058	5216	831	2376	1889	8883
	1925,	687	2199	752	1762	1439	3961
	1924,	665	1703	852	1667	1517	3370
	1923,	196	409	431	698	627	1107
	1922,	280	732	369	702	649	1434

It will be seen that the number of British ships sending these messages increased from 687 in 1925, to 1058 in 1926. This was due in a large measure to the co-operation of the Navy, mentioned in a previous paragraph. The number of ships of other nationalities increased from 752 in 1925 to 831 in 1926 and the number of messages received from these ships increased from 1762 to 2376, an appreciable increase, but still representing only a small percentage of the ships within call of Hong Kong.

An appeal for regular observations from ships has been made through the International Commission for Maritime Meteorology.

Results of Weather Forecasts.—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, together with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1921	65	30	5	0
1922	67	30	3	0
1923	66	30	3	1
1924	71	24	5	0
1925	62	34	4	0
1926	72	26	2	0

The forecast comprises wind direction, wind force, and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings.—The symbols of the China Seas Storm Signal Code are displayed on Kowloon Signal Hill.

The following Ports are warned by a telegraphic adaptation of the code:—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phulien, Taihoku, Manila, Labuan, and Singapore. 156 storm warnings were sent in 1926. 110 were received from Manila and 106 from Zikawei. 28 were received from Phulien, via Quang Chau Wan Radio Station. The corresponding numbers in 1925 were 94, 119, 61 and 8 respectively.

At the request of the Director General of Indian Observatories arrangements were made with the Eastern Extension Telegraph Co., in 1925 to send warnings to Simla of any typhoon passing westward over Indo-China. Only one such warning was necessary during the year; namely, on November 8.

The Day Signals of the Local Code are displayed at the following stations:—

Royal Observatory
H.M.S. Tamar
Gough Hill
Standard Oil Co. Lai
Chi Kok.
Harbour Office

Green Island
Hong Kong and Kow-
loon Wharf and Go-
down Co. Kowloon
Field Officer's Quar-
ters Lyemun.

The Night Signals are displayed at sunset, at the following stations:—

Royal Observatory	H.M.S. Tamar
Harbour Office	Gough Hill
Railway Station	

They have the same signification as the day signals.

A translation of both Day and Night Signals is displayed at the General Post Office and at the Upper Tram Station.

When local signals are displayed in the Harbour a Cone is exhibited at the following stations:—

Gap Rock	Stanley	Sau Ki Wan	Sha Tau Kok
Waglan	Aberdeen	Sai Kung	Tai Po

It has been decided to amend the supplementary storm warning after March 1st, 1927, as follows:—

When Local Signals are displayed in the Harbour, signals will be displayed as follows:—

When No 1 Signal is displayed in the Harbour.

Red T by day.

2 Red Lights vertically by night.

When Nos. 2 to No. 7 Signals are displayed in the Harbour.

Black Cone by day.

2 Green Lights vertically by night.

These Signals will be displayed at the following Stations:—

Aberdeen	Saikung
Cheung Chow	Shataukok
Gap Rock	Tai Po
Ping Shan	Tsun Wan
Stanley	Tai O
Shaukiwan	Waglan

In the following table are given the number of times and number of hours the local signals were hoisted in each of the years 1922-1926:—

Year.	Red Signals.		Black Signals.		Bombs.
	Number of times.	Number of hours displayed.	Number of times.	Number of hours displayed.	Number of times fired.
1922	7	181	6	154	...
1923	11	181	8	252	2
1924	10	186	4	85	...
1925	5	128	3	57	...
1926	5	50	4	103	1

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signal indicates that a depression or typhoon exists which may possibly cause a gale at Hong Kong within 24 hours. The black signals indicate that a gale is expected at Hong Kong.

Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &c.

Logs received.—In addition to meteorological registers kept at about 40 station in China, meteorological logs were received from 230 ships operating in the Far East. These logs, representing 8,680 days' observations have been utilised for amplifying the weather maps and verifying typhoon tracks. The corresponding figures for the year 1925 were 158 and 6,697.

Comparison of Barometers.—The corrections to ships' barometers are usually obtained by comparing their readings while at Hong Kong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

VII.—MAGNETIC OBSERVATIONS.

Magnetic horizontal force, declination, and dip are observed once a month. In the dip observations 4 needles are used in rotation, the result for each month being the mean of determinations with two needles.

In the following table are given the annual values of the magnetic elements in 1926, as derived from observations made in the new magnetic hut with magnetometer Elliott 83 and dip circle Dover 71:—

Declination (West)	0.29.6
Dip (North)	30.42.4
Horizontal Force (C.G.S. unit)	0.37323
Vertical Force (C.G.S. unit)	0.22167
Total Force (C.G.S. unit)	0.43409

The magnetic observatory buildings at Au Tau, for absolute observations and photographic registration of the magnetic horizontal force, vertical force, and declination were commenced in November. It is expected that they will be completed in February 1927.

The vertical force variometer was received on April 30, the horizontal force and declination variometers and earth inductor on June 22. These instruments are similar to those

supplied to the Greenwich Observatory by the Cambridge Instrument Company. A unifilar instrument for absolute determinations of Horizontal Force and Declination was received on January 24, 1927. It was constructed by Messrs. Cooke, Troughton & Simms, and is a modified form of the Indian pattern designed by Captain H.A.D. Fraser, R.E. for the Indian Government.

No aluminium was used in its construction as this metal perishes in the climate of Hong Kong. Micrometers with phosphor bronze screws and springs are fitted in place of verniers. They read to 0'.1 and to 0'.01 by estimation. The deflected magnet is fitted with a collimator lens at one end and a cross, ruled on optical glass, at the other end, thus eliminating Fraser's subsidiary collimator.

The vibration magnet is similarly fitted, the reading of the vertical line of the cross on each magnet being observed on a scale in the eye end of the telescope. The torsion weight for use with the deflected magnet is a zylonite disc mounted on a metal spindle. When used for the vibration magnet a metal disc of the proper weight is added, and a further weight when used in the moment of inertia determinations.

The observing telescope is capable of rotation about a horizontal axis and gives excellent definition at 24 diameters.

VIII.—TIME SERVICE.

Time Ball.—The Time Ball on Kowloon Signal Hill is dropped at 10 a.m. and 4 p.m. daily, except on Saturdays when it is dropped at 10 a.m. and 1 p.m., and on Sundays and Holidays when it is dropped at 10 a.m. only (120th Meridian Time).

The Ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

Time Signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. The lights are extinguished momentarily every second from 8h. 55m. to 9h. 0m. p.m., except at the 28th, 29th, 54th, 55th, 56th, 57th, 58th and 59th seconds, of each minute. The 9 p.m. signals were repeated at midnight on December 31st, the last signal indicating the close of the year 1926. The hours refer to Hong Kong Standard Time (8 hours East of Greenwich).

The Time Ball was dropped successfully 655 times. There was one failure, on October 2nd, when the line was disconnected by P.W.D. workmen before 10h. thus causing the ball to fall prematurely. It was not raised at 11h. as work on the line was still in progress. The ball was not raised on July 22nd or September 27th at 10h. a.m. or 4h. p.m. owing to high wind.

In the following table is given the number of times different errors occurred in the years 1925 and 1926:—

Error of Time Ball.	Number of Times.	
	1925	1926
0·3 sec. or less	631	650
0·4 "	12	4
0·5 "	8	...
0·6 "	5	...
0·7 "	3	...
0·8 "	...	1
0·9 "	2	...

The error of 0.8 sec, which occurred on February 18th, was owing to accidental over-correction of the Mean Time clock.

The Mean probable error of the time ball in each month of the past five years is given in the following table:—

Month.	Probable Error of the Time Ball.				
	1922	1923	1924	1925	1926
January,	±0·10	±0·16	±0·26	±0·38	±0·13
February,	·15	·14	·13	·22	·18
March,	·12	·11	·17	·22	·11
April,.....	20	·18	·27	·16	·13
May,	·10	·13	·23	·11	·10
June,	·11	·21	·27	·10	·10
July,	·14	·12	·21	·10	·10
August,.....	·10	·28	·16	·12	·10
September,	·15	·24	·13	·10	·10
October,	·10	·15	·18	·12	·11
November,	·17	·21	·14	·10	·10
December,.....	·10	·13	·12	·10	·13
Means,	±0·13	±0·17	±0·19	±0·15	±0·12

Time Signals by Radio-Telegraphy.—In addition to the time signals given by the Time Ball, and on the radio mast, signals are broadcast at 10h. and 21h. by radio telegraphy via Stonecutters. Particulars of the programme are given in Government Notification No. 428 of 6.8.26.

The following table gives particulars of the time-signals received by radio telegraphy during the year:—

Station.	Time of Emission.	No of Observations.
	<i>h</i>	
Pearl Harbour	8 a.m.	104
‡ Pearl Harbour	10.30 a.m.	21
* Nauen	8 a.m.	295
† Nauen	8 a.m.	275
Malabar	9 a.m.	45
Manila	11 a.m.	103
* Bordeaux	4 p.m.	153
† Bordeaux	4 p.m.	127

*International Code

†Rhythmic Signals

‡International Longitude Commission Signals.

The regular observation of the Nauen time signal at 8h. a.m. continues to be an invaluable check on clock performance. The signal consistently maintains a high degree of accuracy; its regular reception, and the performance of the Cottingham clock, have eliminated all but small discrepancies in the computed clock errors over cloudy periods.

Transit Instrument.—Routine transit and level observations were made by the Chinese computers throughout the year. The Collimation and Azimuth determinations and occasional transit observations were made by the Chief and First Assistants.

The number of observations in the years 1925 and 1926 was as follows:—

	1925.	1926.
Transits	1375	1325
Level determinations	702	689
Azimuth determinations	54	119
Collimation determinations	54	102

To obviate any possible level effect of a lamp at one end of the transit axis, the wiring for the electric illumination of the transit instrument was altered on April 22, to enable both east and west lamps to be lighted simultaneously. Formerly a two-way switch lighted each lamp separately.

Clocks.—Sidereal clock Cottingham and Mercer, No. 507, has been in use as the Observatory Standard throughout the year.

Between January 1st and October 12th, the daily losing rate varied from $-0s.36$ to $+0s.33$, following generally the variations in pressure in the clock case. The clock stopped on October 12th, and various adjustments were made between October 13th and October 30th. It has been undisturbed since, the rate varying with pressure from $+0s.55$ to $+0s.23$. There has been no leakage into the clock case, the variations of pressure corresponding to those of temperature.

The Sidereal Clock, Dent 39741, was cleaned and the rate altered on February 4th; its rate was again altered on May 6th, May 9th, July 6th and August 28th, the tendency of previous years (a steady increase in losing rate), being particularly marked.

The Mean Time clock, Leroy 1350, was used for dropping the Time Ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10 a.m. and before 4 p.m. by the electric regulating apparatus. The daily rate of the pendulum is kept below 0.5 sec. by the addition or withdrawal of weights. Mean Time clock Dent, 39740, has been corrected daily and its rate regulated as in the case of Leroy 1350.

Chronometer Dent No. 40917 is on loan to Stonecutters Radio Station.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light and Power Co., Ltd., by the rotary converter or the Tungar rectifier.

IX.—MISCELLANEOUS.

Seismograph.—210 earthquakes were recorded during the year by the Milne-Shaw Seismograph, as against 159 in 1925. The number for 1926 includes a series of 18 small earthquakes on August 5-6, 6 on August 7-8, and 4 on August 16. The seismograms have been forwarded to the President of the Seismological Committee, Oxford.

Upper Air Research.—35 flights with pilot balloons were made during the year, supplemented by 21 flights in seaplanes by Officers of H.M.S. *Hermes* and *Vindictive*, who observed the dry and wet bulb temperatures, usually at intervals of 500 feet up to 15000 feet; or the maximum possible under prevailing conditions.

The results of the observations have been communicated to the Secretary of the International Committee for Upper Air

Research, London. Of the days for international balloon ascents, May 7 and 8 were cloudy, a balloon was sent up on May 10, but burst after 15 minutes. On the morning of May 14 a balloon burst after 32 minutes' flight, one balloon burst before ascent and another after 2 minutes' flight.

Upper air temperatures were secured by Flying Officer N. Young, R.A.F. and the late Lieut. M.A. Maude R.N. on May 10, 11, 12, 13, 14 and 15.

Eclipse of the Sun.—The total Solar Eclipse of 1926, January 14 was observed at Hong Kong as a partial eclipse.

The sky was cloudless until 16h. 30m. when thin clouds gathered. The first contact occurred at 14h. 59m. 37s. (120th Meridian time) and the last contact (observed through thin cloud) occurred at 16h. 58m. 17s. The magnitude of the eclipse was 0.43.

One of the spots in the centre group of 2 spots was eclipsed at 15h. 45m. 07s. and emerged at 16h. 36m. 36s. The other was eclipsed at 15h. 59m. 40s. Its emergence was not observed.

The observations were made with a 3-inch comet seeker by projecting a 4-inch image of the sun on to a screen. The last contact, however, owing to cloud, was observed in the telescope with a sun glass.

The diagram at the end of the report, constructed from eye observations made every minute, shows the variations of magnetic declination during the eclipse. No effect on the temperature or pressure of the air could be detected on the autographic records.

The diminution of light was only very faintly perceptible.

International Longitude Determination.—In October the vernier time signals sent out at 0001-0006 G.M.T. from Nauen were observed by ear on 27 days and those sent out at 0801-0806 G.M.T. from Bordeaux were observed on 16 days.

The 0340-0345 G.M.T. vernier time signals from Honolulu were heard on 13 days, but atmospheric conditions at that time were invariably adverse to satisfactory reception. The Time Signals from Manila were observed on 5 days.

From the 6th to the 17th of October, owing to a partial failure of an electric contract, the performance of the sidereal clock, Cottingham & Mercer, was poor.

In November the Nauen and Bordeaux signals were observed on 25 and 17 days respectively. The Honolulu signals were observed on 7 days and the Manila signals on 2 days. During this month, except for a cloudy period between November 14 to November 21, the determinations of local time were good.

Definite corrections to the received signals are not yet available, so that no further pronouncement on the question of the longitude of the transit instrument can be made at present.

Additional Site for Non-Local Typhoon Signals.—The new Peninsula Hotel having obscured the view of the Time Ball and Non-Local Typhoon Signals from certain parts of the Harbour, arrangements were made with the Hong Kong and Kowloon Wharf and Godown Co. to repeat the non-local typhoon signals on the roof of No. 49 Godown. The service will come into operation after 1st March, 1927.

The question of raising the existing Time Ball Tower is under consideration.

Record Room.—The Old Time Ball Tower in the grounds of the Water Police Station, which had for many years been used as a Record Room was handed over to the Police in May, in exchange for a room in the Police Station.

Visitors.—A party of 20 undergraduates from the Hong Kong University visited the Observatory on April 21, and two parties of 25 boys from the Union Middle School, Canton, on October 25 and 26. Also a party of 20 Y.W.C.A. girls on November 10.

On November 23, Professor Woodman of New York University, in charge of 400 undergraduates on an eight months' cruise on board the S.S. Ryndham came to the Observatory to obtain information on the Climate of Hong Kong for educational purposes. He was presented with the following publications.—

“The Climate of Hong Kong”

“The Winds of Hong Kong”

and Daily Weather Maps of the Far East for July to September 1926.

Father E. Gherzi S.J. of the Zikawei Observatory visited the Observatory on June 9 and 10, to compare his barometer with the Observatory Standard and to discuss meteorological matters generally. He was on a tour of inspection of meteorological stations belonging to the Chinese Maritime Customs.

Mr. Santiago Ribot of the Observatoria Fabra, Barcelona, visited the Observatory on October 9 and the Rev: Dr. E. F. Pigol S.J., director of the River View College Observatory, Sydney, on December 11.

Father Miguel Selga S.J., the successor to Father Algué as director of the Philippines Weather Bureau, visited the Observatory on his way to the Pan Pacific Conference at Tokio. We discussed meteorological matters in general, and the adoption by the Japanese Authorities of the Hong Kong telegraphic code in particular. Father Selga again visited the Observatory on his return from the Conference and informed me that as Dr. Okada, the director of the Tokio Observatory, was in Europe the question of adopting the Hong Kong telegraphic code would have to remain in abeyance until his return. Dr. Okada, with Dr. Fujiwhara, came to see me on his return from Europe and promised to consider the matter.

Staff.—No change occurred in the European or Local Staff during the year. Mr. C.W. Jeffries, Chief Assistant, was on leave of absence from March 6 to 1927, January 7. During this period Mr. B. D. Evans acted as Chief Assistant. Mr. Evans was on sick leave from July 24 to 27 and from December 12 to January 18, 1927.

Lau Pak Wah acted as Clerical Assistant during the absence on leave of Badan Singh from October 1, 1925, to June 14th, 1926.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows.—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1917	26,890.50	4,192.72	.....
1918	20,028.24	.....	6,862.26
1919	23,450.57	3,422.33	.....
1920	25,965.66	2,515.09	.....
1921	32,700.51	6,734.85	.....
1922	38,350.10	5,649.59	.....
1923	38,522.58	172.48	.....
1924	52,638.49	14,115.91	.....
1925	41,955.51	.....	10,682.98
1926			

Acknowledgements.—Acknowledgements are here made to the Naval Authorities for their co-operation in securing daily observations from H.M. Ships and upper air temperatures by means of sea planes; particularly to Commander S.E. Thomas R.N., Flying Officer N. Young, R.A.F., Lieut. M.A. Maude R.N. (deceased) and Lieut. H.M.A. Day R.M., to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs authorities, for daily observations and extra observations during typhoon weather, to the Telegraph Companies for transmitting the majority of the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties.

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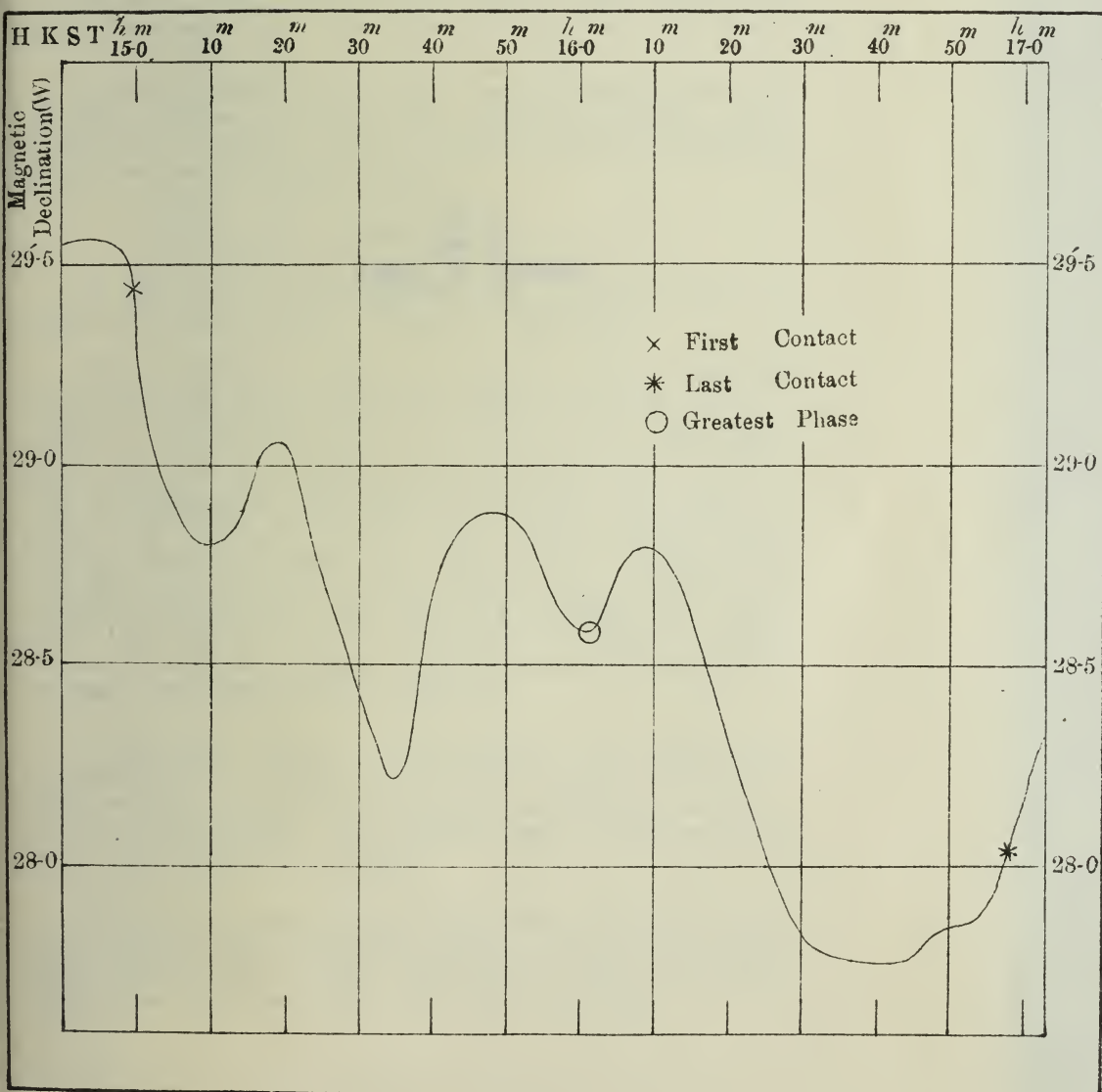
Director.

17th February, 1927.

UNIVERSITY OF ILLINOIS

ROYAL OBSERVATORY, HONG KONG.

Magnetic Declination during the Partial Eclipse of the Sun On 1926, January, 14.



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REPORT OF THE DIRECTOR
OF THE ROYAL OBSERVATORY, HONG KONG,
FOR THE YEAR 1927.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department. The paths, which were badly damaged by the floods of May, July and August, were repaired by the Public Works Department in November. Attempts were made to prevent the roof of the main building from leaking, but without success.

Magnetic Station at Au Tau.—The buildings for the new Magnetic Station at Au Tau were completed in March. The co-ordinates of the pier used for absolute measures of magnetic declination and horizontal force are:—

Latitude $22^{\circ} 26' 50''.6$ N.

Longitude $114^{\circ} 2' 40''.5$ E.

A description of the buildings and instruments will be given in the first Bulletin of magnetic observations.

The site chosen in 1924 was about 150 yards to the east of the Au Tau Police Station but objections to its use as a magnetic station were raised by the Chinese of a neighbouring village. Another site, in view of the Police Station, was therefore chosen in my absence; but the Chinese again objected and in deference to their wishes the present site, about 30 yards to the NNW, was adopted; the offending buildings being obscured from the village by a small hillock. Unfortunately it is also obscured from the Police Station; moreover there is no suitable azimuth mark visible from the observing hut; a pipe on a house about a mile to westward is available in clear weather, but for use in misty weather a mark has been painted on rising ground 50 yards to westward.

Underground Chamber for Seismograph and Clocks.—The diurnal inequality of temperature in the underground chamber continues to be negligible, its automatic registration has therefore been discontinued. The annual range in 1927 amounted to $11^{\circ}.6$ as against $9^{\circ}.1$ in 1926.

The humidity also shows no appreciable diurnal inequality, but is seriously affected by large changes in the open air. The annual range in 1927 was 42%, the same as in 1926. Automatic registration was discontinued at the end of the year.

In the following table the mean monthly temperature and humidity in the Underground Chamber are compared with the temperature and humidity in the Open Air.

Mean Monthly Temperature and Relative Humidity in the Underground Chamber and in the Open Air, during the year 1927.

Month 1927.	In Underground Chamber.		In the Open Air.		Excess of Under- ground Chamber over Open Air.	
	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity
	°	%	°	%	°	%
January, ..	70·7	66	59·7	74	+ 11·0	— 8
February, ..	68·7	69	58·5	73	+ 10·2	— 9
March,	67·7	73	60·1	80	+ 7·6	— 7
April,	68·8	87	67·2	84	+ 1·6	+ 3
May,	72·1	96	75·6	86	— 3·5	+ 10
June,	75·7	97	81·6	84	— 5·9	+ 13
July,	78·1	95	81·9	84	— 3·8	+ 11
August, ...	79·2	95	82·1	85	— 2·9	+ 10
September	79·3	88	79·3	80	...	+ 8
October, ..	77·8	75	74·8	71	+ 3·0	+ 4
November,	76·2	65	71·0	64	+ 5·2	+ 1
December,	74·0	68	65·5	72	+ 8·5	— 4

II.—METEOROLOGICAL INSTRUMENTS.

Barometers.—The Marvin compensated barometer worked satisfactorily during the year. On January 13 the coil of the combined buzzer and hourly time-mark apparatus was burnt out, owing to the tongue of the relay sticking. When repaired separate coils were provided for the time-mark apparatus and the buzzer, with more satisfactory results.

The station barometer No. 1323 and the large Casella barometer were compared with the Observatory Standard on June 23 and December 3.

Beckley Anemograph.—This instrument was oiled and the orientation of the vane checked once a month.

Dines-Baxendell Anemograph.—This instrument was dismantled on January 14. The cistern was cleaned, fresh distilled water provided and a film of liquid paraffin poured on the water before inserting the float, in order to prevent evaporation inside and outside the float.

522.1

4757

1927

— 3 —

The action of the float having become unusually sluggish at low wind velocities, on April 12 a buzzer was fitted so as to vibrate the spindle of the float every minute. This however had no appreciable effect. The instrument was therefore again dismantled on May 19. It was found that the liquid paraffin had mixed with the water and so caused the float to stick. The mixture was poured away and replaced by fresh distilled water, on which was poured sufficient kerosene to make a very thin surface film. The performance of the instrument has since been more satisfactory. The action of the buzzer is now to bring the float gradually to its correct position when, in nearly calm weather, it tends to stick. This may take several hours to achieve.

The instrument was calibrated on February 15 and August 23.

The mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1926 are given in the following table, together with the results for 1927:—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor ($\text{Dines} \div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1926.	1927.
January,	1'94	1'88
February,	1'97	2'22
March,	2'02	2'56
April,	2'04	2'68
May,	2'17	2'83
June,	2'10	2'75
July,	2'23	2'60
August,	2'20	2'79
September,	2'22	2'14
October,	2'12	2'17
November,	2'00	2'27
December,	1'92	2'14
Year.....	2'08	2'42

Thermometers.—All thermometers in use are compared with Kew Standard No. 647 in winter and summer.

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura pluviograph and the amount of sunshine by two Campbell-Stokes universal sunshine recorders. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hong Kong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal features of the Weather.—The principal features of the weather in 1927 were:—

- (a) Rainfall very considerably above normal in May and considerably above normal in July and August. 6.01 inches fell from May 6 to 8 and 15.75 inches from May 17 to 24.
- (b) Temperature considerably below normal in March and April and considerably above in November and December.
- (c) A typhoon which passed a few miles to the South of Hong Kong in the morning of July 25, causing a moderate gale. Another typhoon which passed a few miles to the South of Gap Rock in the morning of August 20, causing a violent gale at Hong Kong.

Barometric Pressure was persistently below normal from January to August, and again in November and December. In September it was considerably above normal and in October moderately above. The mean pressure for the year at station level (109 feet above sea level) was 29.830 ins. as against 29.857 ins. in 1926 and 29.842 for the past 44 years. The highest pressure was 30.305 ins. on February 7 as against 30.384 ins. in 1926 and 30.509 ins. for the past 44 years. The lowest pressure was 28.927 ins. on July 25 as against 29.229 ins. in 1926 and 28.590 ins. for the past 44 years.

The temperature of the air was considerably below normal in March and April and considerably above in November and December. The mean temperature for the year was 71°.4 as against 71°.6 in 1926 and 71°.8 for the past 44 years. The highest temperature was 93°.1 on August 19, as against 92°.5 in 1926 and 97°.0 for the past 44 years. The lowest temperature was 45°.9 on February 7, as against 43°.2 in 1926 and 32°.0 for the past 44 years.

The rainfall was very considerably above normal in May and considerably above normal in July and August. The total for the year was 107.86 ins. as against 100.78 ins. in 1926 and 86.06 ins. for the past 44 years. The greatest fall in one civil day was 7.25 ins. on May 23 as against 21.02 ins. in 1926; the highest on record. The greatest fall in one hour was 2.10 ins. between 12½h. and 13½h. on May 1, as against 3.96 ins. in 1926; also the highest on record.

The wind velocity was normal in April and December, but below normal in every other month; considerably in October and November. The mean velocity for the year was 11.7 m.p.h. as against 12.2 m.p.h. in 1926 and 12.5 m.p.h. for the past 44 years. The maximum velocity for one hour, as recorded by the Beckley anemograph, was 83 m.p.h. at 14h. and 16h. on August 20, as against 75 miles in 1926 and 108 miles for the past 44 years. The maximum squall velocity, as recorded by the Dines-Baxendell anemograph, was at the rate of 116 m.p.h. at 15h. 23m. on August 20 as against 101 m.p.h. in 1926 and 130 m.p.h. for the past 18 years.

The relative humidity was slightly above normal in January and February, and from May to September. In December it was considerably above normal. The mean relative humidity for the year was 78% as against 79% in 1926 and 77% for the past 44 years. It frequently exceeded 95% and the lowest for the year was 24% on December 9 as against 17% in 1926 and 4% for the past 44 years.

Rainfall at four Stations.—In the following table the monthly rainfall for the year 1927 at the Observatory is compared with the fall at the Police Station, Tai Po; the Botanical Gardens; and the Matilda Hospital, Mount Kellet:—

Month.	Observatory (Kowloon).	Police Station (Tai Po).	Botanical Gardens (Hong Kong).	Matilda Hospital (Hong Kong)
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	0·310	0·13	0·44	0·41
February, ...	4·350	4·64	4·66	3·33
March,	4·535	6·48	4·90	4·95
April,	7·125	7·81	8·08	6·70
May,	25·445	15·82	26·88	19·23
June,	11·680	9·64	13·29	9·32
July,	18·735	29·64	21·85	16·71
August,	20·905	8·66	23·37	13·11
September, ...	6·165	5·44	6·59	4·41
October,	5·420	4·53	6·46	5·52
November, ...	1·825	2·20	1·32	0·50
December, ...	1·370	0·20	2·27	1·90
Year....	107·865	95·19	120·11	86·09

Floods.—The heaviest rainfall occurred at the Observatory as follows:—

<i>Period.</i>				<i>Amount.</i> inches.	<i>Duration.</i> hours.	<i>Greatest fall in 1 hour.</i>	
						<i>Amount.</i> inches.	<i>Time.</i>
d.	h.	d.	h.				d. h.
May ... 6	1	to May 8	2	5.92	14	1.64	May 6 2
May ... 17	14	to May 25	0	15.75	53	1.89	May 23 2
June ... 7	2	to June 10	14	6.28	56	0.62	June 7 2
June ... 30	5	to July 2	19	8.51	26	1.40	June 30 23
July ... 24	17	to July 26	10	5.84	35	0.75	July 26 5
Aug. ... 20	5	to Aug. 21	8	8.33	26	1.28	Aug. 20 16
Aug. ... 29	17	to Aug. 31	13	4.53	17	1.62	Aug. 30 2

Landslides and floods were caused by these rains.

The wireless mast at the Observatory was struck by lightning during a thunder storm on August 10. The operator was thrown out of his chair.

Typhoons.—The tracks of 19 typhoons and 21 of the principal depressions which occurred in the Far East in 1927 are given in two plates in the Monthly Meteorological Bulletin for December, 1927.

A typhoon passed a few miles to the South of the Observatory on a WNW track on the morning of July 25. By this time its violence had abated, however. It produced only a moderate gale at Hong Kong. Another typhoon which passed about 70 miles to the South of the Observatory in the forenoon of August 20, on a westerly track, produced a violent gale at Hong Kong. The maximum squall velocity was at the rate of 116 m.p.h. at 15h. 23m. A typhoon formed to the North of the Paracels on the morning of November 20. It approached Hong Kong but filled up on reaching the land. The maximum squall velocity was at the rate of 74 m.p.h. at 12h. 27m. A depression formed near Pratas on the morning of August 30 and passed between Hong Kong and Gap Rock in the afternoon. The wind velocity increased from 11 m.p.h. at 13h. to 28 m.p.h. at 14h. and a squall at the rate of 57 m.p.h. occurred at 14h. 23m. By 19½h. it was dead calm.

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East, for 6 a.m. of the 120th. meridian time, is constructed daily and lithographed at the Observatory. On the verso is printed the morning weather report, from about 40 stations in China, Indo-China, Japan, Borneo and the Philippines, and a weather forecast for the following districts:—

1. Formosa Channel.
2. S. E. Coast of China between Hong Kong and Lamocks.
3. Hong Kong to Gap Rock.
4. S. Coast of China between Hong Kong and Hainan.

This publication is exhibited on notice boards at the Hong Kong and Kowloon Ferry Piers, the Harbour Office, at the offices of the Cable Companies and, since November 18, at the General Post Office. It is also distributed to subscribers to the "Daily Bulletin" and to various officials. Copies are sent weekly to the Hydrographic Office, Bangkok. A weather map for 2 p.m. of the 120th meridian time is also constructed daily. It is not published but an evening weather report and forecast based thereon is telephoned to the morning papers and exhibited on the notice boards.

The service of daily weather broadcasts, formerly undertaken by Cape d'Aguilar, was transferred to the Observatory W/T Station on April 1. This station now broadcasts meteorological observations from 26 stations in the Far East at 0400 G.M.T. and from 19 stations at 1200 G.M.T. with repetitions at 0500 and 1300 G.M.T. All on 800 metres I.C.W. The transmitter being of the valve type, 1.5 kilo-watts. It also listens on 800 metres.

The change from 600 to 800 metres was made on account of the jamming on 600 metres. The experiment has not been very successful, however. Some ships cannot send on 800 metres and the range of the Observatory Station is smaller than that of Cape d'Aguilar. Hence the number of observations received from ships was considerably less in 1927 than in 1926. It is proposed however to continue the experiment for at least another typhoon season.

A circular is being issued drawing attention to the fact that the Observatory Station, in accordance with the latest practice, is sharply tuned, and it is hoped that this will induce ships' operators to persevere in their efforts to communicate with the Observatory. It is also anticipated that as the existence of the Station becomes more generally known, the number of weather reports will increase.

Typhoon warnings are broadcast by Cape d'Aguilar on a 600 metre spark, and repeated on 800 metres I.C.W. by the Observatory Station at 18 minutes past every hour and also on 300 metres telephony at 48 minutes past every hour.

V.—WEATHER TELEGRAMS, FORECASTS AND STORM WARNINGS.

Daily Weather Telegrams.—In addition to the ordinary 6h. and 14h. observations, which the Cable Companies transmit free of charge, the 11h. and 17h. observations were received at half rates from the following stations:—

Shanghai	Macao	Phu-lien
Gutzlaff	Lao Kay	Tourane
Amoy	Yunnan	Cape St. James.

The 6 a.m. observations from Pelew were received regularly by radio-telegraphy until May 27, and from October 21. Since when the 6 a.m. observations at Saipan and Ponape have been included in the message.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hong Kong:—Amoy, Canton, Macao, Phulien, Sharp Peak and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The 9 p.m. observations from Swatow, kindly sanctioned by the Chinese Telegraph Administration, were occasionally received the same evening, but usually on the next or following day.

The Director of the Taihoku Observatory sends extra weather telegrams from the two stations in Formosa nearest to the centre during the passage of a typhoon.

Weather Telegrams from Ships by Radio.—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately):—

Month.	British (including H.M. Ships).				Other National- ities.		Total.		
	No. of ships.	No. of messages.	H.M.S. in ports.		No. of ships.	No. of messages.	No. of ships.	No. of messages.	
			No. of ships.	No. of messages.					
January,	71	225	15	259	72	198	158	682	
February,	44	147	14	285	62	180	120	612	
March,.....	44	179	19	259	45	204	108	642	
April,	37	121	20	194	23	65	80	380	
May,	42	124	12	146	26	109	80	379	
June,	45	131	8	83	26	69	79	283	
July,	48	129	9	113	33	87	90	329	
August,	44	117	9	87	31	109	84	313	
September,	46	182	11	140	31	107	88	429	
October,	48	198	14	94	39	112	101	404	
November,	39	106	8	90	29	100	76	296	
December,	36	143	15	88	18	46	69	277	
Totals {	1927,	544	1802	154	1838	435	1386	1133	5026
	1926,	1058*	5216*	831	2376	1889	8883
	1925,	687	2199	752	1762	1439	3961
	1924,	665	1703	852	1667	1517	3370
	1923,	196	409	431	698	627	1107

* British, including H.M. Ships.

It will be seen that the number of British ships sending these messages decreased from 1058 in 1926 to 698 in 1927. The number of ships of other nationalities decreased from 831 to 435.

During the first three months of the year 1927 (before the service was taken over by the Observatory W/T Station) the number of British ships sending was 227 as against 232 in the first three months of 1926, and the number of ships of other nationalities was 179 as against 162 in 1926.

On April 1 Stonecutters W/T Station ceased to be available for the reception of meteorological observations from H.M. ships. The latter were accordingly instructed to transmit the observations direct to the Observatory station. The result of the order was that no observations were received from H. M. ships, except from those stationed at Swatow and Canton, or at sea a short distance from Hong Kong. On July 21 this was reported to the Naval Authorities, who, after investigation found it possible to suspend the order, temporarily. Meteorological observations from H.M. ships are now being received via Stonecutters as well as by the Observatory station.

Father Gherzi, of the Zikawei Observatory, after patient experiment and with the utmost good will, has recently inaugurated a short wave broadcast service, by which we obtain at 9h. 45m. the 6h. observations from 7 stations on the Yangtze and North China. The thanks of all concerned are due to Father Gherzi for these valuable observations.

The Meteorological Authorities at Pratas continue to send, with commendable regularity and promptitude, their 6h., 11h., 14h. and 17h. observations and the 6h. observations from some Philippine stations. They also send hourly observations during the passage of a typhoon.

On 1928, January 15 and 18, observations from 12 stations in the Korean réseau were received via Pratas. It is very desirable that these observations should be received regularly, direct by Cape d'Aguilar.

The 6 a.m. and 2 p.m. observations from Phu-lien, Tourane, Cape St. James and Kwong Chow Wan, are received by radio-telegraphy via Hanoi. The morning message contains also the 4 p.m. observations of the previous day from Lao Kay and Yunnan, and the evening message contains the 10 a.m. observations of the same day from these stations. A request has recently been sent for observations from Donghoi and Nhattrang, as data from these stations would increase the accuracy and utility of the weather map.

The Japanese Authorities have not yet found it possible to adopt the Hong Kong 6-letter Code in their daily weather telegrams. We are still being deprived, therefore, of temperature and weather data from the Japanese réseau.

Results of Weather Forecasts.—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, together with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1922	67	30	3	0
1923	66	30	3	1
1924	71	24	5	0
1925	62	34	4	0
1926	72	26	2	0
1927	70	26	4	0

The forecast comprises wind direction, wind force, and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings.—The symbols of the China Seas Storm Signal Code are displayed on Kowloon Signal Hill and on the roof of No. 49 Godown of the Hong Kong and Kowloon Wharf and Godown Co.

The following Ports are warned by a telegraphic adaptation of the code:—Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phulien, Taihoku, Manila, Labuan and Singapore. 136 storm warnings were sent in 1927. 154 were received from Manilâ, and 188 from Zikawei. The corresponding numbers in 1926 were 156, 110 and 106 respectively.

At the request of the Director of Indian Observatories arrangements were made with the Eastern Extension Telegraph Co., in 1925 to send warnings to Simla of any typhoon passing westward over Indo-China. Only three such warnings were necessary during the year; namely, on July 27, September 20 and October 7. The warnings are now sent to Calcutta to which station the service has been transferred.

The Day Signals of the Local Code are displayed at the following stations:—

Royal Observatory	Green Island
H.M.S. "Tamar"	Hong Kong and Kowloon
Gough Hill	Wharf & Godown Co.,
Standard Oil Co.,	Kowloon.
Lai Chi Kok	Field Officer's Quarters,
Harbour Office.	Lyemun.

The Night Signals are displayed at sunset, at the following stations:—

Royal Observatory	H.M.S. "Tamar"
Harbour Office	Gough Hill
Railway Station	

They have the same signification as the day signals.

A translation of both Day and Night Signals is displayed at the General Post Office and at the Upper Tram Station.

When Local Signals are displayed in the Harbour signals are displayed at out stations as follows:—

When No. 1 Signal is displayed in the Harbour.

Red T by day.

2 Red Lights vertically by night.

When Nos. 2 to 7 Signals are displayed in the Harbour.

Black Cone by day.

2 Green Lights vertically by night.

These Signals will be displayed at the following Stations:—

Aberdeen	Saikung
Cheung Chow	Shataukok
Gap Rock	Tai Po
Ping Shan	Tsun Wan
Stanley	Tai O
Shaukiwan	Waglan

In the following table are given the number of times and number of hours the local signals were hoisted in each of the years 1923-1927:—

Year.	Red Signals.		Black Signals.		Bombs.
	Number of times.	Number of hours displayed.	Number of times.	Number of hours displayed.	Number of times fired.
1923	11	181	8	252	2
1924	10	186	4	85	...
1925	5	128	3	57	...
1926	5	50	4	103	1
1927	8	169	4	61	1

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signal indicates that a depression or typhoon exists which may possibly cause a gale at Hong Kong within 24 hours. The black signals indicate that a gale is expected at Hong Kong.

Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

Arrangements were made early in the year for the more rapid dissemination of typhoon warnings by telephone. The Observatory now warns 6 Stations, 3 of which are distributing Stations. Of these one warns 7 stations, 3 of which are distributing stations. Of the latter, one warns 11 stations, 2 of which are distributing stations. In all 86 stations or officials are warned.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &C.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 169 ships operating in the Far East. These logs, representing 7,221 days' observations have been utilised for amplifying the weather maps and verifying typhoon tracks. The corresponding figures for the year 1926 were 230 and 8,680.

Comparison of Barometers.—The corrections to ships' barometers are usually obtained by comparing their readings while at Hong Kong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

VII.—MAGNETIC OBSERVATIONS.

Magnetic horizontal force, declination, and dip are observed at the observatory once a month. In the dip observations 4 needles are used in rotation, the result for each month being the mean of determinations with two needles.

In the following table are given the annual values of the magnetic elements in 1927, as derived from observations made in the magnetic hut with magnetometer Elliott 83 and dip circle Dover 71:—

	° ,
Declination (West)	0.31.7
Dip (North)	30.39.9
Horizontal Force (C.G.S. unit)	0.37376
Vertical Force (C.G.S. unit)	0.22161
Total Force (C.G.S. unit)	0.43452

Monthly determinations of horizontal force and declination have been made at the new Magnetic Station, Au Tau, simultaneously with those at the Royal Observatory from March to Decémber inclusive, the new Magnetometer (Cooke Troughton and Simms No. 31) being utilised for the purpose.

The results (mean for 10 months) are:—

	° ,
Declination (West)	0.44.4
Horizontal Force (C.G.S. unit)	0.37433

No observations of dip were made as the inductor received in 1926 had to be returned for repair. It was not received back until late in the year and several difficulties had to be overcome before the instrument could be brought into regular use.

A comparison of the two magnetometers was made at the Royal Observatory during January and February, and indicates that a correction of $+ 9\gamma$ is necessary to reduce the horizontal force results by the Cooke instrument to those of Elliott No. 83. No appreciable difference was found in declination determinations.

The Au Tau Station is $27\frac{1}{2}$ miles by road from the Royal Observatory. Owing to time spent in travelling, necessary reconstruction of piers, difficulties with electric light, and alteration to the magnetic apparatus the requisite adjustments have only recently been completed. It is hoped to commence registration in February, 1928. Transport to Au Tau has been mainly furnished by the Railway Department during the year but this is not entirely satisfactory as a car cannot always be obtained at short notice.

VIII.—TIME SERVICE.

Time Ball.—The Time Ball on Kowloon Signal Hill is dropped at 10h. and 16h. daily, except on Saturdays when it is dropped at 10h. and 13h. and on Sundays and Holidays when it is dropped at 10h. only (120th Meridian Time).

The Ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

Time Signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. The lights are extinguished momentarily every second from 20h. 55m. to 21h., except at the 28th, 54th, 55th, 56th, 57th, 58th and 59th seconds, of each minute. The 21h. signals were repeated at midnight on December 31st, the last signal indicating the close of the year 1927. The hours refer to Hong Kong Standard Time (8 hours East of Greenwich).

The Time Ball was dropped successfully 659 times. There was one failure, on May 17th at 10h. owing to an electrical defect; the ball was successfully dropped at 11h. however. The ball was not raised on August 20th and August 30th at 10h. or 16h. owing to high wind; also on August 23rd owing to electrical defects.

The error of the Time Ball due to the accumulated error of the standard clock during cloudy periods was $+0s.8$ on January 11th., $+0s.6$ on January 13th. and $-0s.4$ on August 19th; it was $+1s.6$, $+0s.4$ and $+1s.1$, due to over correction of the mean time clock on July 4d. 10h, October 17d. 16h. and December 2d. 10h. respectively. On all other occasions the error was $0s.3$ or less. The sign $+$ indicates that the Time Ball was late. .

The probable error of the time ball in each month of the past five years is given in the following table:—

Month.	Probable Error of the Time Ball.				
	1923	1924	1925	1926	1927
January,	±0·16	±0·26	±0·38	±0·13	±0·14
February,	·14	·13	·22	·18	·12
March,	·11	·17	·22	·11	·11
April,	·18	·27	·16	·13	·10
May,	·13	·23	·11	·10	·14
June,	·21	·27	·10	·10	·13
July,	·12	·21	·10	·10	·10
August,	·28	·16	·12	·10	·12
September,	·24	·13	·10	·10	·10
October,	·15	·18	·12	·11	·11
November,	·21	·14	·10	·10	·10
December,	·13	·12	·10	·13	·13
Means,	±0·17	±0·19	±0·15	±0·12	±0·12

Time Signals by Radio-Telegraphy.—In addition to the time signals given by the Time Ball, and on the radio mast, signals are broadcast at 10h. and 21h. by radio-telegraphy, via Stonecutters until March 31 and subsequently via Cape D'aguiar. Particulars of the programme are given in Government Notifications Nos. 428 of 6.8.26. and 111 of 25.2.27.

333 observations of the rhythmic radio time signals emitted by Nauen at 8h. a.m., Hong Kong Standard Time, have been made during the year and 81 observations of a similar signal emitted by Bordeaux at 4 p.m. Hong Kong Standard Time.

The observations have been utilized for clock regulation during cloudy weather and have been tabulated for longitude determinations. These cannot be completed until the errors of the time signals are received.

The results of observations made in 1926 are as follows:—

Station.	No. of Observations.	Deduced Longitude of Hong Kong.		
		h.	m.	s.
Nauen	272	7.	36.	41.15 E
Bordeaux	125	7.	36.	41.29 E

From observations of the Bordeaux signals in October and November, 1926, differences of longitude between Hong Kong and 9 other observatories have been determined as follows:—

	<i>h.</i>	<i>m.</i>	<i>s.</i>
Shanghai	+	0. 29.	1.68
Washington	—	12. 44.	56.95
Tsingtau	+	0. 24.	35.60
Helwan	—	5. 31.	19.35
Dehra Dun	—	2. 24.	29.39
Algiers	—	7. 24.	32.69
Athens	—	6. 1.	49.35
Paris	—	7. 27.	20.21
Cape of Good Hope	—	6. 22.	46.60

+ Signifies *E* of Hong Kong

— Signifies *W* of Hong Kong

Transit Instrument.—Routine transit and level observations were made by the Chinese computers throughout the year. The Collimation and Azimuth determinations and occasional transit observations were made by the Chief and First Assistants.

The number of observations in the years 1926 and 1927 was as follows:—

	1926	1927
Transits	1325	1156
Level determinations	689	566
Azimuth determinations (mark) ...	119	42
Azimuth determinations (transits of circumpolar stars)	—	121
Collimation determinations (mark)	102	44

Clocks.—Sidereal clock Cottingham and Mercer, No. 507, has been in use as the Observatory Standard throughout the year. It stopped on February 19th owing to a defective battery. The losing rate was altered before re-starting, and since that date has varied between — 0s.12 (on March 2nd and 26th) and + 0s.53 (on October 15th) corresponding to variations of pressure in the clock case.

The Sidereal clock, Dent 39741, was cleaned and the rate altered on August 17. Since that date, its rate has been altered as found necessary to keep its error approximately the same as Cottingham.

The Mean Time clock, Leroy 1350, was used for dropping the Time Ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the

Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10*h.* and 16*h.* by the electric regulating apparatus. The daily rate of the pendulum is kept below 0.5 sec. by the addition or withdrawal of weights. Mean Time clock Dent, 39740, has been corrected daily and its rate regulated as in the case of Leroy 1350.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light and Power Co., Ltd., by the rotary converter or the Tungar rectifier.

IX.—MISCELLANEOUS.

Seismograph.—New mirrors were fitted to both components of the Milne-Shaw Seismograph. 202 earthquakes were recorded during the year as against 210 in 1926. A large earthquake was recorded on May 23. The amplitude was greater than in the Japanese earthquake of 1923, August 31—September 1. The seismograms have been forwarded to the President of the Seismological Committee, Oxford.

Upper Air Research.—11 flights with pilot balloons were made during the year, supplemented by 2 from H.M.S. “Argus” (Lieut.-Commander A. E. Dodington, R.N.) and 16 temperature flights in sea planes were made by Lieut.-Commander H. S. Murray Smith, R.N., who also observed upper air wind direction and velocity on four occasions, by means of smoke bursts from H.M.S. “Hermes” when at sea. Lieut.-Commander Dodington similarly observed wind direction and velocity on 2 occasions at Wei Hai Wei and on 4 occasions between Wei Hai Wei and Hong Kong.

The following days were selected by the International Commission as days for international ascents. February 15-17, June 13-18 and October 17-22. October was chosen as the “international month”.

No balloon ascents were made from the Observatory on February 15-17 on account of cloud, but Lieut.-Commander Murray Smith secured temperature observations in a sea plane up to 14,400 feet on February 15 and up to 11,000 feet on February 16, under unfavourable conditions. On February 17 conditions were too bad for flying.

By the end of April our stock of hydrogen was exhausted owing to leakage from the cylinders, and no funds were available for a further supply. Temperature flights were made by Lieut.-Commander Murray Smith, however, at Hong Kong on June 15-18 and by Lieut.-Commander Dodington, off Shanghai, on June 14-17.

The results of the Pilot balloon observations have been forwarded to the Secretary of the International Commission for the exploration of the upper air. The results of the temperature flights have been tabulated, but they are not sufficiently numerous for discussion at present.

On January 13 and 30 Commander A. L. Jackson, R.N., H. M. Survey Ship "Iroquois" and Lieut.-Commander H. V. Silk, R.N., H. M. Survey Ship "Herald", brought new pattern declinometers to be compared with the Observatory Standard. A report on the performance of each was furnished.

Visitors.—A party from the Y.W.C.A. visited the Observatory on March 16, the Ranger Company of Girl Guides on June 30, and 20 students of the Canton Middle School on October 14.

Naval Officers' Course of Meteorology.—Lieut.-Commander J. A. B. Willson, R.N. and Lieutenant G. A. M. Williams, R.N., of H.M.S. "Vindictive", took a course of meteorology at the Observatory between July 4 and August 22.

Air Route to Shanghai.—On November 24 Flying Officer R. Vanghan Williams R. A. F. came to interview the Director in connection with the establishment of an air route from Hong Kong to Shanghai.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows:—

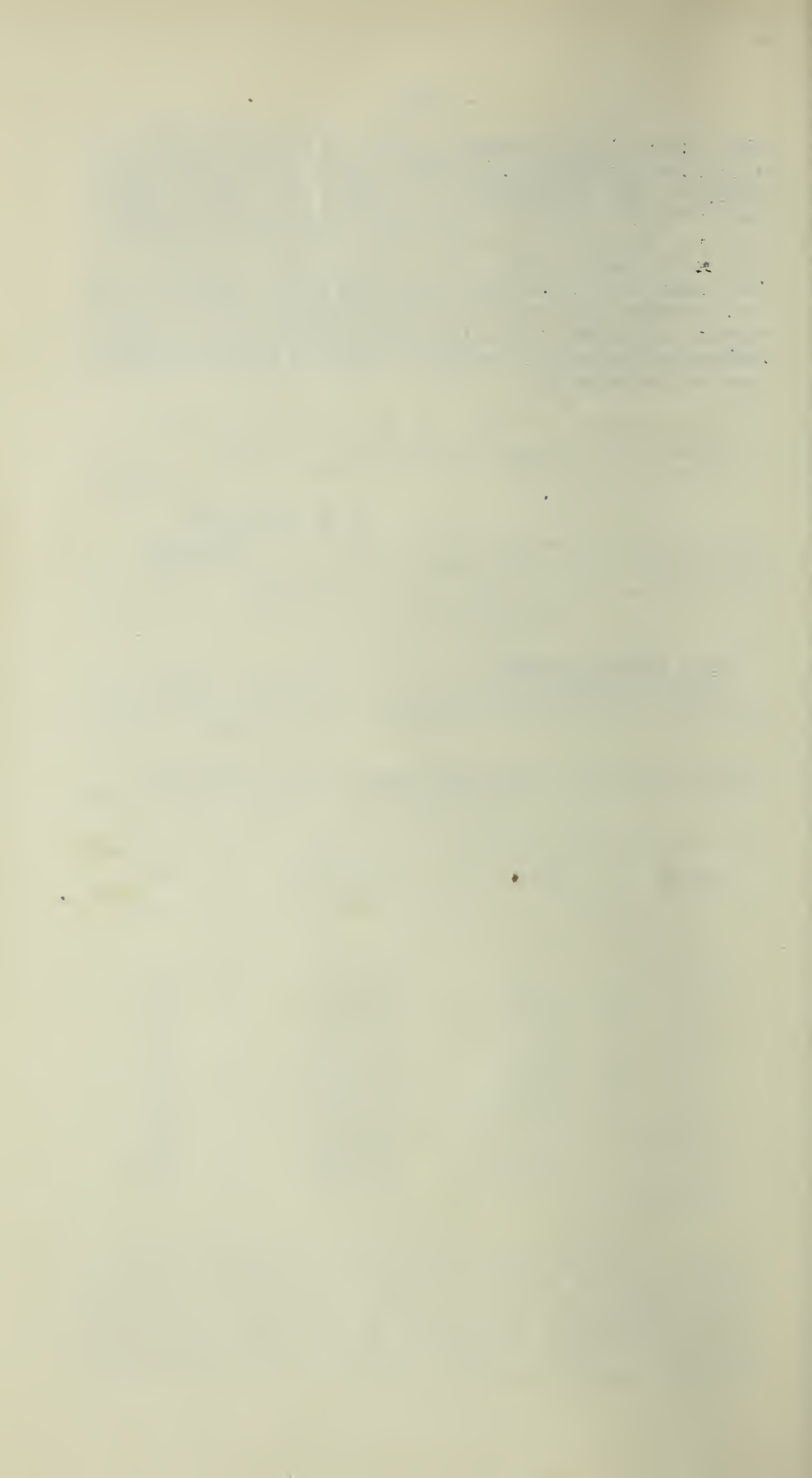
Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1918	20,028.24	.....	6,862.26
1919	23,450.57	3,422.33	.....
1920	25,965.66	2,515.09	.....
1921	32,700.51	6,734.85	.....
1922	38,350.10	5,649.59	.....
1923	38,522.58	172.48	.....
1924	52,638.49	14,115.91	.....
1925	41,955.51	.....	10,682.98
1926	45,158.87	3,203.36	.....
1927	36,664.99	.....	8,493.88

Acknowledgements.—Acknowledgements are here made to the Naval Authorities for their co-operation in securing daily observations from H.M. ships and upper air temperatures by means of sea planes; to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs Authorities, for daily observations by cable and radio-telegraphy, and extra

observations during typhoon weather, to the Telegraph Companies for transmitting the majority of the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio-telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties. Special mention should be made of the services rendered by Messrs. Jeffries and Evans in mounting and adjusting the new magnetic instruments at Au Tau.

T. F. CLAXTON,
Director.

23rd February, 1928.



REPORT OF THE DIRECTOR
OF THE ROYAL OBSERVATORY, HONG KONG,
FOR THE YEAR 1928.

I.—GROUND AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies. The concrete path on the slope from the Nathan Road entrance was continued to the eastern entrance in December.

The Time Ball Tower on Kowloon Signal Hill was raised 20 feet between April 29 and October 10. The ball is now visible from the bridge of all steamers in harbour, except those in wharves Nos. 2 and 5 immediately to the West of the godowns of the Hong Kong and Kowloon Godown Company.

The Anemomograph Hut at the Peak was demolished on December 7, the site being required for a wireless mast. A new Hut was erected on a site 28 feet North and 53 feet East of the centre of the old Hut.

Magnetic Station at Au Tau.—The doors and bolts were adjusted and the roof of the magnetograph building repaired during the year.

Underground Chamber for Seismographs and Clocks.—The range of temperature in the underground chamber was 10°.7 (F) in 1928 as against 11°.6 (F) in 1927 and 9°.1 (F) in 1926. The relative humidity was seldom less than 93% between May 7 and August 23. The range during the year being 27% in 1928 as against 32% in 1927 and 42% in 1926.

In the following table the mean monthly temperature and humidity in the Underground Chamber are compared with the temperature and humidity in the open air.

*Mean Monthly Temperature and Relative Humidity in the
Underground Chamber and in the Open Air
during the year 1928.*

Month 1928.	In Underground Chamber.		In the Open Air.		Excess of Under- ground Chamber over Open Air.	
	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity
	°	%	°	%	°	%
January, ..	69.6	71	61.6	83	+ 8.0	- 12
February, ..	69.9	67	58.7	82	+ 11.2	- 15
March,	69.6	76	63.2	87	+ 6.4	- 11
April,	71.1	83	70.9	81	+ 0.2	+ 2
May,	74.1	94	77.4	86	- 3.3	+ 8
June,	76.2	94	79.9	83	- 3.7	+ 11
July,	78.5	94	83.5	80	- 5.0	+ 14
August, ...	80.2	92	82.4	84	- 2.2	+ 8
September	80.3	87	81.6	75	- 1.3	+ 12
October, ..	78.4	85	75.1	65	+ 3.3	+ 20
November,	76.7	89	69.3	67	+ 7.4	+ 22
December,	74.3	90	65.6	72	+ 8.7	+ 18
Range, . .	10.7	27	24.8	22	...	...

II.—METEOROLOGICAL INSTRUMENTS.

All the meteorological instruments were maintained in good order throughout the year.

The thermometers in use were compared with Kew Standard No. 647 in Summer and Winter.

The working of the electric contact on the Nakamura Pluviograph is tested daily at 11h.

The Beckley and Dines Baxendell Anemographs were oiled and the orientation of the vanes checked once a month. The Dines Baxendell instrument continues to work satisfactorily, except at very low velocities when its action is uncertain.

The mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1927 are given in the following table, together with the results for 1928:—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor ($\text{Dines} \div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1927.	1928.
January,	1'83	2'13
February,	1'88	2'07
March,	1'94	2'15
April,	1'96	2'01
May,	2'20	1'97
June,	2'13	1'73
July,	2'25	1'88
August,	2'23	1'94
September,	2'22	1'95
October,	2'12	2'21
November,	2'02	2'16
December,	1'93	2'13
Year.....	2'06	2'03

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and of the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura Pluviograph and the amount of sunshine by two Campbell-Stokes universal sunshine recorders. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hong Kong Standard time. The character and direction of the motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers.

Principal features of the Weather in 1928.—The principal features of the weather in 1928 were:—

- (a) Absence of typhoons.
- (b) Serious shortage of rain from the middle of July to the end of the year.
- (c) Temperature above normal in January, July and December.

Barometric Pressure was below normal in every month except in February and October, when it was considerably above. The mean pressure for the year at station level (109 feet above sea level) was 29.828 ins., as against 29.830 ins. in 1927 and 29.842 for the past 45 years. The highest pressure was 30.312 ins. on February 19 as against 30.305 ins. in 1927 and 30.509 ins. for the past 45 years. The lowest pressure was 29.227 ins. on July 14 as against 28.927 ins. in 1927 and 28.590 ins. for the past 45 years.

The temperature of the air was moderately above normal in January and July and considerably above in December. It was moderately below in June and October.

The mean of the daily maximum temperatures in July was 88°.5; the highest on record, except in 1889 when it was 88°.7. The mean temperature for the month, 83°.5, was also the highest on record, except in 1889 when it was 83°.6. The mean of the daily minimum temperatures, 79°.9, was the same as the previous highest on record, which also occurred in 1889.

The mean temperature for the year was 72°.4 as against 71°.4 in 1927 and 71°.8 for the past 45 years. The highest temperature was 92°.6 on July 30 as against 93°.1 in 1927 and 97°.0 for the past 45 years. The lowest temperature was 45°.0 on February 1, as against 45°.9 in 1927 and 32°.0 for the past 45 years.

The rainfall was considerably above normal in May, very considerably below in July and considerably below in September. From October 19 to the end of the year only 0.850 inch fell; 0.585 inch of which fell on November 13-14. The total for the year was 71.155 ins. as against 107.865 ins. in 1927 and 85.726 ins. for the past 45 years. The greatest fall in one civil day was 4.100 ins. on May 29 as against 7.255 ins. in 1927. The greatest fall in one hour was 1.700 inch between 12½h. and 13½h. on June 1, as against 2.100 ins. in 1927.

The wind velocity was normal in March and slightly above normal in December. In all other months it was below normal, considerably so in February, May, July, October and November. The mean velocity for the year was 11.2 m.p.h. as against 11.7 m.p.h. in 1927 and 12.5 m.p.h. for the past 45 years. The maximum velocity for one hour, as recorded by the Beckley anemograph, was 59 m.p.h. at 1h. on July 15, as against 83 miles in 1927 and 108 miles for the past 45 years. The maximum gust velocity, as recorded by the Dines-Baxendell anemograph, was at the rate of 76 m.p.h. at 23h. 20m. on July 14 as against 116 m.p.h. in 1927 and 130 m.p.h. for the past 19 years.

The relative humidity was considerably above normal in January and moderately above in February, March and December. The mean relative humidity for the year was 79% as against 78% in 1927 and 77% for the past 45 years. It frequently exceeded 95% and the lowest for the year was 25% on November 21 as against 24% in 1927 and 4% for the past 45 years.

Rainfall at four Stations.—In the following table the monthly rainfall for the year 1928 at the Observatory is compared with the fall at the Police Station, Tai Po; the Botanical Gardens; and the Matilda Hospital, Mount Kellet:—

Month.	Observatory (Kowloon).	Police Station (Tai-po).	Botanical Gardens (Hong Kong).	Matilda Hospital (Hong Kong)
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	1·880	1·19	2·17	1·25
February, ...	3·570	2·18	3·87	4·05
March,	5·185	3·26	6·37	5·52
April,	4·105	4·81	6·68	7·88
May,	18·410	13·61	19·13	16·72
June,	15·130	16·91	13·64	10·80
July,	4·780	3·71	3·37	1·95
August,	12·910	8·63	17·98	11·45
September,...	3·915	3·50	6·34	7·50
October,	0·435	0·09	0·38	0·48
November,...	0·815	3·94	0·94	0·74
December, ...	0·620	0·00	0·02	0·00
Year....	71·155	61·83	80·89	68·34

Floods.—Little or no damage was caused by floods during the year 1928. The heaviest rainfall occurred at the Observatory as follows:—

Period 1928.				<i>Amount.</i> inches.	<i>Duration.</i> hours.	<i>Greatest fall in 1 hour.</i>			
d.	h.	d.	h.			<i>Amount.</i> inches.	<i>Time.</i>		
Mar. ...	6 5 to	Mar. 7	13	3·63	29	0·80	Mar.	7	7
Apr. ...	19 7 to	Apr. 22	22	3·84	53	1·06	Apr.	22	3
May ...	22 5 to	June 2	19	14·83	75	1·70	May	1	13
June ...	30 17 to	July 2	11	3·58	11	0·68	June	30	22
Aug. ...	4 13 to	Aug. 6	18	4·71	17	1·64	Aug.	5	13

Typhoons.—The tracks of 21 typhoons and 10 of the principal depressions in the Far East in 1928 are given in the monthly Meteorological Bulletin for December.

No typhoon passed near Hong Kong in 1928, the greatest wind (gust) velocity during the year being at the rate of 76 m.p.h. from E by N at 23h. 20m. on July 14, when a typhoon, which had been approaching Hong Kong, curved to westward and passed about 100 miles South of the Observatory.

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East, for 6 a.m. of the 120 meridian time, is constructed daily and lithographed at the Observatory. On the verso is printed the morning weather report, from about 40 stations in China, Indo-China, Japan, Borneo and the Philippines, and a weather forecast for the following districts:—

1. Formosa Channel.
2. S.E. Coast of China between Hong Kong and Lamocks.
3. Hong Kong to Gap Rock.
4. S. Coast of China between Hong Kong and Hainan.

This publication is exhibited on notice boards at the Hong Kong and Kowloon Ferry Piers, the Harbour Office, at the offices of the Cable Companies and, since November 18, 1927, at the General Post Office. Formerly copies were sent, free of charge, to subscribers to the "Daily Bulletin", but as on March 31 publication of this Bulletin ceased, arrangements were made by which local firms, and others interested in the Daily Weather Report and Map, should receive a copy through the Chamber of Commerce, on payment of an annual subscription of \$10.00. At the close of the year there were 55 such subscribers. The Weather Report and Forecast, and all Storm Warnings are telephoned to Stone-cutters Wireless Station for transmission to ships on the China Station.

A weather map for 2 p.m. of the 120th. meridian time is also constructed daily. It is not published, but an evening weather report and forecast based thereon, is sent to the morning papers and exhibited on the notice boards.

Meteorological observations from 26 stations in the Far East, followed by a Weather Report and Forecast, are broadcast by Cape d'Aguilar (V.P.S.) on a 600 * metre spark at 0400 and 1200 G.M.T. A repetition of the 0400 message is made by V.P.S. on 2800 metres I.C.W. at 0500, and of the 1200 message on 2000 metres I.C.W. immediately following the 1300 time-signal.

*Changed from 800 metres on June 1.

The Weather Reports and Forecasts are also broadcast by the Observatory Station (G.O.W.) on 300 metres telephony at 0548 and 1148 G.M.T.

Hong Kong Storm Warnings are broadcast by V.P.S. on a 600 metre spark on receipt, and at 18 minutes past every hour until 1600 G.M.T.

G.O.W. normally broadcasts these warnings on 300 metre telephony immediately following the 0548 and 1148 weather reports, but when Hong Kong local typhoon signals are displayed they are broadcast by telephony on receipt, and at 48 minutes past every hour until the signals are lowered.

Shanghai and Manila Warnings are broadcast by V.P.S. on a 600 metre spark on receipt, and repeated after an interval of 10 minutes. They are similarly broadcast by G.O.W. on 300 metres telephony when the Hong Kong local typhoon signals are displayed.

V.—WEATHER TELEGRAMS, FORECASTS AND STORM WARNINGS.

Daily Weather Telegrams.—In addition to the ordinary 6h. and 14h. observations, which the Cable Companies transmit free of charge, the 11h. and 17h. observations were received at half rates from the following stations:—

Shanghai	Gutzlaff	Amoy	Macao
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Since August 15 the 2300 and 0700 G.M.T. observations from Fort Bayard, Phu-lien, Tourane, Cape Padaran and Cape St. James, and the 0300 and 0900 G.M.T. observations from the above, and about 12 other stations in Indo-China, have been received from Phu-lien on short wave.

This service is very valuable and ensures the early receipt of the observations, and at regular hours, namely:—at 0115, 0400, 0830 and 1015 G.M.T. It also saves the expense of obtaining the 0300 and 0900 G.M.T. observations by cable.

Other valuable services are the 2200 G.M.T. observations on short wave from Yangtze Ports, and several stations in N.E. China sent personally by Father Gherzi S. J. of the Zi Ka Wei Observatory, and the 2100 G.M.T. observations from Pelew, Yap, Saipan and Ponape, sent on 1050 metres from the Pelew Observatory at 0200 G.M.T.

Since September 29 the 0600 and 2200 G.M.T. observations from Hoihow have been received by wireless telegraphy occasionally.

The Meteorological Authorities at Pratas continue to send, with commendable regularity and promptitude, their 6*h.*, 11*h.*, 14*h.*, and 17*h.* observations and the 6*h.* observations from some Philippine stations. They also send hourly observations during the passage of a typhoon.

Though the number of observations received for constructing the daily weather maps has increased of late years, owing to the advent of wireless telegraphy, far more observations are still required before even approximately accurate maps can be drawn, showing kinks in the isobars, lines of discontinuity, cold fronts, warm fronts etc. At present the observations of temperature are so few that no attempt is made to draw isotherms on the weather maps.

Proposals for the establishment of additional wireless meteorological reporting stations are to be submitted to the Pan-Pacific Science Conference which will take place in Batavia next May, and to the Conference of British meteorologists, which is to take place in London next August.

Monsieur Jean Coffin, of the French Meteorological Service, while on a tour of the Far East in connection with an improved service of wireless meteorological broadcasts, visited the Observatory on January 31 and March 3. He informed me that the Tokio Observatory proposed to send the 6 a.m. observations from 20 stations in the Japanese Empire daily to the Naha Wireless Station, which would broadcast them on short wave, using the Hong Kong 6-letter telegraphic Code. He also stated that observations might be expected from a high power station in Hankow at an early date; no details of the above schemes are to hand.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hong Kong:—Amoy, Canton, Macao, Phu-lien, Sharp Peak and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The 9 p.m. observations from Swatow, kindly sanctioned by the Chinese Telegraph Administration, were occasionally received; but usually on the next or following day. The Director of the Taihoku Observatory sends extra weather telegrams from the two stations in Formosa nearest to the centre during the passage of a typhoon.

Weather Telegrams from Ships by Radio.—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately):—

Month.	British (including H.M. Ships).				Other National- ities.		Total.		
	No. of ships.	No. of messages.	H.M.S. in ports.		No. of ships.	No. of messages.	No. of ships.	No. of messages.	
			No. of ships.	No. of messages.					
January,	44	137	18	63	31	95	93	295	
February,	45	175	16	56	26	77	87	308	
March,.....	56	203	14	83	37	118	107	404	
April,	49	153	23	91	19	73	91	317	
May,	48	147	21	110	29	95	98	352	
June,	81	215	14	82	50	131	145	428	
July,	91	237	14	102	78	215	183	554	
August,	74	257	13	115	59	184	146	556	
September,	81	290	16	108	67	195	164	593	
October,	84	301	18	125	62	214	164	640	
November,	75	322	20	116	64	302	159	740	
December,	61	208	16	151	66	194	143	553	
Totals {	1928,.....	789	2645	203	1202	588	1893	1580	5740
	1927,.....	544	1802	154	1838	435	1386	1133	5026
	1926,.....	1058	5216	831	2376	1889	8883
	1925,.....	687	2199	752	1762	1439	3961
	1924,.....	665	1703	852	1667	1517	3370

Communication was effected on a wave-length of 600 metres until 1927, April 1st, and on 800 metres until 1928, May, 7th. Wave-lengths of 600 metres and 2,800 metres (H.M. Ships) have been employed since.

It will be seen that the number of British ships sending these messages increased from 698 in 1927 to 992 in 1928. The number of ships of other nationalities increased from 435 to 588.

Results of Weather Forecasts.—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, together with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1923	66	30	3	1
1924	71	24	5	0
1925	62	34	4	0
1926	72	26	2	0
1927	70	26	4	0
1928	66	31	3	0

The forecast comprises wind direction, wind force, and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings.—The symbols of the China Seas Non-local Storm Signal Code are displayed on Kowloon Signal Hill and on the roof of No. 49 Godown of the Hong Kong and Kowloon Wharf and Godown Co.

The following Ports are warned by a telegraphic adaptation of the code:—Shanghai, Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phu-lien, Taihoku, Manila, Labuan and Singapore. 103 storm warnings were sent in 1928. 187 were received from Manila, and 144 from Zikawei. The corresponding numbers in 1927 were 136, 154 and 188 respectively.

Calcutta was warned on August 26 and 27 of the passage of typhoons across Indo-China in a westerly direction.

The Day Signals of the Local Code are displayed at the following stations:—

Royal Observatory	Green Island
H.M.S. "Tamar"	Hong Kong and Kowloon
Gough Hill	Wharf & Godown Co.,
Standard Oil Co.,	Kowloon.
Lai Chi Kok	Field Officer's Quarters,
Harbour Office	Lyemun.

The Night Signals are displayed at sunset, at the following stations:—

Royal Observatory	Gough Hill
Harbour Office	Field Officer's Quarters,
Railway Station	Lyemun (since 1928,
H.M.S. "Tamar"	July).

They have the same signification as the day signals.

A translation of both Day and Night Signals is displayed at the General Post Office and at the Upper Tram Station.

When Local Signals are displayed in the Harbour signals are displayed at out-stations as follows:—

When No. 1 Signal is displayed in the Harbour.

Red T by day.

2 Red Lights vertically by night.

When Nos. 2 to 7 Signals are displayed in the Harbour.

Black Cone by day.

2 Green Lights vertically by night.

These Signals are displayed at the following stations:—

Aberdeen	Shataukok
Cheung Chow	Tai Po
Gap Rock	Tsun Wan
Ping Shan	Tai O
Stanley	Waglan.
Saikung	

In the following table are given the number of times and number of hours the local signals were hoisted in each of the years 1924-1928:—

Year.	Red Signals.		Black Signals.		Bombs.
	Number of times	Number of hours displayed.	Number of times.	Number of hours displayed.	Number of times fired.
1924	10	186	4	85	...
1925	5	128	3	57	...
1926	5	50	4	103	1
1927	8	169	4	61	1
1928	1	10	2	58	...

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signal indicates that a depression or typhoon exists which may possibly cause a gale at Hong Kong within 24 hours. The black signals indicate that a gale is expected at Hong Kong.

Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

Arrangements were made early in the year 1927 for the more rapid dissemination of typhoon warnings by telephone. The Observatory now warns 6 stations, 3 of which are distributing stations. Of these one warns 7 stations, 3 of which are distributing stations. Of the latter, one warns 11 stations, 2 of which are distributing stations. In all 86 stations or officials are warned. This service requires specially qualified operators at the Exchanges, who come on duty when the red signal is hoisted.

Special forecasts and storm warnings were issued to the Far Eastern Flight during their passage from Singapore to Hong Kong and return, in November.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &c.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 186 ships operating in the Far East. These logs, representing 9425 days' observations have been utilised for amplifying the weather maps and verifying typhoon tracks. The corresponding figures for the year 1927 were 169 and 7221.

Comparison of Barometers.—The corrections to ships barometers are usually obtained by comparing their readings while at Hong Kong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

VII.—MAGNETIC OBSERVATIONS.

Routine magnetic observations were discontinued at the Royal Observatory at the end of 1927. From the beginning of 1928 Magnetic horizontal force, declination and dip have been determined at the Au Tau Station weekly, when possible. The instruments used are a magnetometer by Cooke, Troughton and Simms, No. 31, and an Earth Inductor by the Cambridge Instrument Co. C65818. In the following table are given the annual values of the magnetic elements in 1928 as derived from 40 determinations:—

Declination (West)	0.43.1
Dip (North)	30.38.8
Horizontal Force (C.G.S. unit)	0.37478
Vertical Force (C.G.S. unit)	0.22207
Total Force (C.G.S. unit)	0.43563

Photographic registration of declination, horizontal force and vertical force was commenced at Au Tau on January 31. The declination registers have been generally satisfactory, but the horizontal and vertical force traces are subject to derangements due to causes at present obscure. The range of temperature in the magnetograph house is too great. Superior insulation and thermostatic control of the inner chamber are desirable.

The assistance of the Officer-in-Charge of the Au Tau Police Station was kindly granted by the Captain Superintendent of Police for changing sheets, battery charging etc., but owing to Police staff changes and illness this plan was abandoned on July 1, when a Chinese attendant was engaged for the work and given quarters in the Police Station. It has been difficult to impress upon the attendant the necessity for extreme care in handling photographic paper, and honesty and promptitude in reporting defects. In consequence much register has been lost, and although some improvement has been recently effected the present arrangements are unsatisfactory. It will ultimately be necessary to adopt others of a more elaborate nature, if reliable results are to be obtained.

VIII.—TIME SERVICE.

Time Ball.—The time ball on Kowloon Signal Hill is dropped at 10*h.* and 16*h.* daily, except on Saturdays when it is dropped at 10*h.* and 13*h.* and on Sundays and Holidays when it is dropped at 10*h.* only (120th Meridian Time).

The ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

Time signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. The lights are extinguished momentarily every second from 20th 55*m.* to 21*h.*, except at the 28th, 29th, 54th, 55th, 56th, 57th, 58th and 59th seconds, of each minute. During the alterations to the time ball tower (referred to in next paragraph) brighter lights were used for the lamp signals, and the programme was repeated at 10*h.* and 16*h.* in the hope that the signals would be observed from ships in the harbour by means of telescopes or binoculars. They were observed by certain ships to the S.E. of the Signal Hill but were not visible from the Harbour Office. The 21*h.* signals were repeated at midnight on December 31 the last signal indicating the close of the year 1928. The hours refer to Hong Kong Standard Time (8 hours East of Greenwich).

The time ball was dropped 365 times without failure. From April 29 to October 11 the apparatus was not in use, owing to alterations to the tower.

The error of the time ball due to accumulated error of the standard clock never exceeded 0*s.*3 throughout the year.

The probable error of the time ball in each month of the past five years is given in the following table. During the period that the time ball was out of action the figures apply to the 10 a.m. radio signals.

Month.	Probable Error of the Time Ball.				
	1924	1925	1926	1927	1928
January,	± 0.26	± 0.38	± 0.13	± 0.14	± 0.13
February, .....	.13	.22	.18	.12	.10
March, .....	.17	.22	.11	.11	.10
April, .....	.27	.16	.13	.10	.10
May, .....	.23	.11	.10	.14	.10
June, .....	.27	.10	.10	.13	.20
July, .....	.21	.10	.10	.10	.11
August, .....	.16	.12	.10	.12	.20
September, .....	.13	.10	.10	.10	.11
October, .....	.18	.12	.11	.11	.11
November, .....	.14	.10	.10	.10	.10
December, .....	.12	.10	.13	.13	.12
Means,	± 0.19	± 0.15	± 0.12	± 0.12	± 0.12

Time Signals by Radio-Telegraphy.—In addition to the time signals given by the time ball, and on the radio mast, signals are broadcast at 10h. and 21h. by radio-telegraphy, via Cape D'aguilar. Particulars of the programme are given in Government Notification No. 322 of 1.6.28.

On December 27 it was found that the programme wheel of the time-signal clock was one second in advance of the second hand. In consequence the radio time signals and the lamp signals have been one second early, probably since May 10, when adjustments were made. This error was eliminated on December 27.

311 observations of the rhythmic radio time signals emitted by Nauen at 8h. a.m., Hong Kong Standard Time, have been made during the year and 80 observations of a similar signal emitted by Bordeaux at 4 p.m. Hong Kong Standard Time.

The observations have been utilized for clock regulation during cloudy weather and have been tabulated for longitude determination. This cannot be completed until the errors of the time signals are received.

The results of observations made in 1927 are as follows:—

Station.	No. of Observations.	Deduced Longitude of Hong Kong.		
		h.	m.	s.
Nauen	332	7.	36.	41.20 E
Bordeaux	80	7.	36.	41.32 E

Transit Instrument.—Routine transit and level observations were made by the Chinese computers throughout the year. The Collimation and Azimuth determinations and occasional transit observations were made by the Chief and First Assistants.

The number of observations in the years 1927 and 1928 was as follows:—

	1927	1928
Transits	1156	1200
Level determinations	566	620
Azimuth determinations (mark)	42	31
Azimuth determinations (transits of circumpolar stars)	121	276
Collimation determinations (mark).	44	41

Clocks.—Sidereal Clock Cottingham and Mercer, No. 507, has been in use as the Observatory Standard throughout the year. Its performance has been marked by a steady increase of losing rate, with superposed fluctuations corresponding to variations of pressure in the clock case due to temperature changes. No increase of pressure due to leakage in the case has been observed. The losing rate varied from +0s.29 (on February 25) to +0s.89 (on October 9). The clock tripped on three occasions owing to defects in the remontoire batteries.

The Sidereal Clock Dent 39741 stopped on November 17 and November 18. It was cleaned and oiled on November 19, since when it has gone without further interruption. The rate has been altered as found necessary in order to keep its error approximately the same as Cottingham.

The Mean Time Clock, Leroy 1350, was used for dropping the time ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10h. and 16h. by the electric regulating apparatus. The daily rate of the pendulum is kept below 0.5 sec. by the addition or withdrawal of weights. Mean Time Clock Dent, 39740, has been corrected daily and its rate regulated as in the case of Leroy 1350.

Batteries, Power Supply, &c.—The necessary current for the Time Service has been supplied by accumulator batteries, charged as found necessary from the alternating mains of the China Light and Power Co., Ltd., by the rotary converter or the Tungar rectifier.

IX:—MISCELLANEOUS.

Seismograph.—No alterations were made to the seismograph during the year. New needle points were fitted as required. As against 202 in 1927, 183 earthquakes were recorded during the year 1928, one of which was felt at Hong Kong; at 10.58.30 p.m. on January 29. During a severe earthquake which occurred about 2500 kms. from Hong Kong, in the early morning of March 10, the seismogram showed an amplitude in a N-S direction of 98 mms. and in an E-W direction 78 mms.

The seismograms have been forwarded to the President of the International Seismological Committee, Oxford, to be dealt with.

Upper Air Research.—64 Balloon ascents were made during the year. 69 temperature flights were made in aeroplanes by Officers of the R.A.F., Kai Tak, and 2 by Officers of H.M.S. "Hermes". On July 23 Flying Officer F.M.V. May reached a height of 19,000 feet in 109 minutes, the temperature at this height being $25^{\circ}7$ (F).

The results of the Pilot balloon observations have been forwarded to the Secretary of the International Commission for the exploration of the upper air.

The results of the temperature flights have been tabulated and plotted. They show a mean lapse rate of $2^{\circ}78$ (F) per thousand feet, up to 15,000 feet, in the Spring and $3^{\circ}00$ (F) in the Summer. In the Autumn and Winter the observations are not sufficiently numerous to admit the calculation of even approximate mean values. The lapse rate of relative humidity is extremely variable in all seasons of the year. During the passage through cloud an increase of humidity will naturally be recorded, but even on clear days there appears to be no definite lapse rate, the humidity curves for individual flights being very irregular. On August 22, though cumulus clouds was prevalent up to 20,000 feet, the humidity fell from 84% at 7,000 feet to 33% at 14,000 feet. On several occasions a dry layer was found from 10,000 to 13,000 feet, between wet layers.

The following days were selected by the International Commission as days for international ascents:—March 12-17, July 17-19 and November 12-17. March was chosen as the "international month". From March 12-17 and November 12-17 the weather at Hong Kong was cloudy.

Visitors.—His Excellency the Officer Administering the Government and Mrs. Southorn visited the Observatory on October 12.

Flying Officer Vanghan Fowler R.A.F. came to interview the Director on February 23 in connection with the meteorological needs of a proposed civil aviation company for Hong Kong.

Professor G. Fenzel visited the Observatory on March 31 in connection with the establishment of meteorological stations throughout Kwangtung.

Lieut: Commander J. H. Drummond R.N., the newly appointed Superintendent of the Chart and Chronometer Department of the Naval Yard and representative of the Air Ministry, visited the Observatory on August 30.

Group Captain Cave Brown Cave R.A.F. and Officers of the Far Eastern Flight visited the Observatory on November 24 and 27, to enquire as to weather conditions. The flight to Indo-China was delayed by a typhoon in the China Sea.

Staff.—No change occurred in the European or Local Staff during the year. Mr. B. D. Evans, First Assistant, was on leave of absence from March 24 to December 23.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows:—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1919	23,450.57	3,422.33	.....
1920	25,965.66	2,515.09	.....
1921	32,700.51	6,734.85	.....
1922	38,350.10	5,649.59	.....
1923	38,522.58	172.48	.....
1924	52,638.49	14,115.91	.....
1925	41,955.51	.....	10,682.98
1926	45,158.87	3,203.36	.....
1927	36,664.99	.....	8,493.88
1928	35,434.52	.....	1,230.47

Acknowledgements.—Acknowledgements are here made to the Naval Authorities for their co-operation in securing daily observations from H.M. ships and upper air temperatures by means of sea planes; to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs Authorities, for daily observations by cable and radio-telegraphy, and extra observations during typhoon weather, to the Telegraph Companies for transmitting the majority of the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio-telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties.

T. F. CLAXTON,
THE LIBRARY OF THE Director.

21st February, 1929.

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REPORT OF THE DIRECTOR
OF THE ROYAL OBSERVATORY, HONG KONG,
FOR THE YEAR 1929.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

A stone for the zero triangulation station was set up by the Public Works Department, 38.5 feet due south of the Observatory transit instrument, on February 2.

The Main Building and the Assistants Quarters were repainted in the Spring.

The tubular steel storm signal mast on Kowloon Signal Hill having been blown down during the typhoon of August 22 was replaced by a lattice steel mast on November 20.

Magnetic Station at Au Tau.—In view of the large range of temperature in the magnetograph house, during the months of June-August the walls of the inner chamber were covered with sheet asbestos, $\frac{3}{4}$ inch thick, on both inner and outer surfaces. The ceiling and floor were covered on the outer surface only. Interior vestibules were constructed at the entrances of the outer and inner chambers, and it is now necessary to pass through five doors in order to reach the recording room from the outer air. The range of temperature has been sensibly reduced by these alterations, but is still too great. To keep it within the necessary limits, thermostatic control will probably be necessary.

Underground Chamber for Seismographs and Clocks.—The range of temperature in the underground chamber was $9^{\circ}.7$ (F) in 1929 as against $10^{\circ}.7$ (F) in 1928 and $11^{\circ}.6$ (F) in 1927. The relative humidity was never less than 95% between June 6 and September 4. The absolute range during the year was 45% in 1929 as against 45% in 1928 and 61% in 1927.

In the following table the mean monthly temperature and humidity in the Underground Chamber are compared with the temperature and humidity in the open air.

*Mean Monthly Temperature and Relative Humidity in the
Underground Chamber and in the Open Air
during the year 1929.*

Month 1929.	In Underground Chamber.		In the Open Air.		Excess of Under- ground Chamber over Open Air.	
	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity
	°	%	°	%	°	%
January, ..	72.4	90	62.5	76	+ 9.9	+ 14
February, ..	70.1	89	58.9	79	+ 11.2	+ 10
March,	70.7	79	64.9	73	+ 5.8	+ 6
April,	72.4	86	71.2	75	+ 1.2	+ 11
May,	75.0	93	78.1	84	- 3.1	+ 9
June,	77.4	96	82.5	79	- 5.1	+ 7
July,	78.8	96	81.6	84	- 2.8	+ 12
August, ...	79.5	96	81.1	85	- 1.6	+ 11
September	79.8	93	81.2	79	- 1.4	+ 14
October, ..	78.9	86	76.5	69	+ 2.4	+ 17
November,	76.3	92	67.7	64	+ 8.6	+ 28
December,	74.4	87	64.7	78	+ 9.7	+ 9
Range,	9.7	...	23.6	...	...

II.—METEOROLOGICAL INSTRUMENTS.

All the meteorological instruments were maintained in good order throughout the year.

The thermometers in use were compared with Kew Standard No. 647 in summer and winter.

The working of the electric hammer on the Nakamura Pluviograph was tested daily at 11h.

The Beckley and Dines Baxendell Anemographs were oiled and the orientation of the vanes checked once a month. The Dines Baxendell instrument continues to work satisfactorily, except at very low velocities when its action is uncertain.

The mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1928 are given in the following table, together with the results for 1929:—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor ($\text{Dines} \div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1928.	1929.
January,	1'94	2'13
February,	1'99	2'11
March,	2'06	2'13
April,	2'08	2'19
May,	2'19	2'25
June,	2'11	2'29
July,	2'23	2'38
August,	2'21	2'55
September,	2'20	2'36
October,	2'12	2'25
November,	2'02	2'20
December,	1'94	2'14
Year.....	2'09	2'25

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet-bulb thermograph, and the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura Pluviograph and the amount of sunshine by two Campbell-Stokes universal sunshine recorders. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hong Kong Standard Time. The character and direction of motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers. Observations of pilot balloons are made in clear weather with a Watts $1\frac{1}{4}$ inch "Coudé" theodolite. It is proposed to send up a small balloon daily, when the balloons arrive, in order to study the winds in the lower strata of the atmosphere.

Principal features of the Weather in 1929:—The principal features of the weather in 1929 were:—

- A severe typhoon on August 22.
- Continuation of the serious shortage of rain (which began in July, 1928) until the middle of June.
- Temperature of the air considerably above normal in January and moderately above from March to June.

Barometric pressure was considerably below normal in July and December and moderately below in January and August. It was considerably above in March, April, September and November. The mean pressure for the year at station level (109 feet above sea level) was 29.845 ins. as against 29.828 ins. in 1928 and 29.842 ins. for the past 46 years. The highest pressure was 30.282 ins. at 9h. 30m. a.m. on December 23 as against 30.312 ins. in 1928 and 30.509 ins. for the past 46 years. The lowest pressure was 28.912 ins. at 1.43 p.m. on August 22 as against 29.227 ins. in 1928 and 28.590 ins. for the past 46 years.

The temperature of the air was considerably above normal in January, and moderately above from March to June and in December. It was moderately below normal in November. The mean temperature for the year was 72°.6 as against 72°.4 in 1928 and 71°.9 for the past 46 years. The highest temperature was 92°.2 at 3h. 0m. p.m. on July 8 as against 92°.6 in 1928 and 97°.0 for the past 46 years. The lowest temperature was 44°.4 at 6h. 55m. a.m. on December 23 as against 45°.0 in 1928 and 32°.0 for the past 46 years.

The total rainfall for the year was 69.82 inches as against 71.15 inches in 1928 and 85.380 ins. for the past 46 years. A water famine resulted from a serious shortage of rain from the middle of July 1928 to the middle of June 1929, when only 27 inches of rain fell against an average of 71 inches. Disaster was averted by a rainfall of 3.8 inches between June 14 and 25, 1929, followed by frequent heavy rain in July, to the extent of 22.7 inches, and in August to the extent of 20 inches. The greatest fall in one civil day was 7.155 inches on August 16 as against 4.100 inches in 1928 and 21.025 inches for the past 46 years. The greatest fall in one hour was 2.730 inches between 3½h. and 4½h. a.m. on August 16, as against 1.700 inch in 1928 and 3.965 inches for the past 46 years.

The wind velocity was very considerably below normal in March, considerably below in February and April, and slightly below in June, July and December. It was slightly above in January and September. The mean velocity for the year was 11.6 m.p.h. as against 11.2 m.p.h. in 1928 and 12.5 m.p.h. for the past 46 years. The maximum velocity for one hour, as recorded by the Beckley anemograph was 89 m.p.h. at 14h. on August 22, as against 59 miles in 1928 and 108 miles for the past 46 years. The maximum gust velocity, as recorded by the Dines-Baxendell anemograph, was at the rate of 117 m.p.h. from E. by S. at 13h. 39m. on August 22, as against 76 m.p.h. in 1928 and 130 m.p.h. for the past 20 years.

The relative humidity was considerably above normal in December and slightly above in January, February, July, August, and September. It was considerably below in March and April and slightly below in October and November. The

mean for the year was 77% as against 79% in 1928 and 77% for the past 46 years. It frequently exceeded 95% in Spring and Summer. The lowest for the year was 26% at 1h. 0m. p.m. on April 20 and at 4h. 0m. p.m. on November 18, as against 25% in 1928 and 12% for the past 46 years.

Rainfall at five Stations.—In the following table the monthly rainfall for the year 1929 at the Observatory is compared with the fall at the Police Station, (Tai Po), the Botanical Gardens, (Hong Kong), the Matilda Hospital, (Mount Kellet, Hong Kong), and Fanling:—

Month.	Observatory (Kowloon).	Police Station (Tai po).	Botanical Gardens (Hong Kong).	Matilda Hospital (Mount Kellet, Hong Kong).	Fanling.
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	0·930	1·48	1·30	0·90	...
February, ...	0·585	0·77	0·70	0·66	...
March,	0·505	0·08	0·91	0·97	...
April,	1·540	0·97	1·22	1·05	1·68
May,	6·620	3·97	7·00	5·48	3·53
June,	4·195	4·07	5·31	3·64	4·11
July,	22·700	20·87	23·23	18·43	24·64
August,	20·020	12·58	20·07	15·12	15·67
September,...	10·795	9·55	9·41	7·07	3·68
October,	0·140	0·00	0·11	0·11	0·03
November, ...	1·375	1·82	1·31	1·62	1·78
December, ...	0·420	0·63	0·59	0·57	0·22
Year....	69·825	56·79	71·16	55·62	55·34*

*From April 1.

Floods.—Little or no damage was caused by floods during the year 1929. The heaviest rainfall occurred at the Observatory as follows:—

Period 1929.				Amount.	Duration.	Greatest fall in 1 hour.	
d.	h.	d.	h.	inches.	hours.	Amount.	Time.
July ...11	0 to	July 15	15	9·48	47	0·900	July 12 9
July ...20	22 to	July 24	3	6·59	28	1·050	July 22 16
July ...26	10 to	July 28	14	4·65	17	0·870	July 28 12
Aug. ...15	2 to	Aug. 19	19	10·96	33	2·730	Aug. 16 4
Sept. ...29	12 to	Oct. 1	2	4·87	15	0·580	Sept. 29 20

Typhoons.—The tracks of 15 typhoons in the Far East are given in the Monthly Meteorological Bulletin for December. On August 22 a typhoon passed between Hong Kong and Gap Rock on a WNW track. The lowest barometer reading, reduced to sea level and standard gravity, was 28.912 inches at 1.43 p.m. The greatest wind velocity (gust) was at the rate of 117 m.p.h. from E by S at 1.39 p.m

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East, for 6 a.m. of the 120 meridian time, is constructed daily and lithographed at the Observatory. On the verso is printed the morning weather report, from 40 to 50 stations in China, Indo-China, Japan, Korea, Borneo and the Philippines, and a weather forecast for the following districts:—

1. Formosa Channel,
2. S. E. Coast of China between Hong Kong and Lamocks.
3. Hong Kong to Gap Rock.
4. S. Coast of China between Hong Kong and Hainan.

This publication is exhibited on notice boards at the Hong Kong and Kowloon Ferry Piers, the Harbour Office, at the offices of the Cable Companies and at the General Post Office. It may be purchased by the general public at a subscription rate of \$10 per annum. During the year 45 companies etc. subscribed for 55 copies. The Weather Report and Forecast, and all Storm Warnings, are telephoned to Stone-cutters Wireless Station for transmission to H. M. Ships on the China Station.

A weather map for 2 p.m. of the 120th. meridian time is also constructed daily. It is not published, but an evening weather report and forecast based thereon, is sent to the morning papers and exhibited on the notice boards.

Meteorological observations from 26 stations in the Far East, followed by a Weather Report and Forecast, are broadcast by Cape d'Aguilar (VPS) on a 600 metre spark at 0400 and 1200 G.M.T. A repetition of the 0400 message is made by VPS on 2913 (2800 until May 31) meters I.C.W. at 0500 and the 1200 message on 2913 (2000 until May 31) meters I.C.W. immediately following the 1300 time-signal.

The Weather Reports and Forecasts are also broadcast by the Peak Wireless Station (ZBW.) on 355 (300 until November 22) metres telephony at 0548 and 1148 G.M.T.

Hong Kong Storm Warnings are broadcast by VPS on a 600 metre spark on receipt, and at 18 minutes past every hour until 1600 G.M.T.

ZBW normally broadcasts these warnings on 355 (300 until November 22) metre telephony immediately following the 0548 and 1148 weather reports, but when Hong Kong local typhoon signals are displayed they are broadcast by telephony on receipt, and at 48 minutes past every hour until the signals are lowered.

Shanghai and Manila warnings are broadcast by VPS on a 600 metre spark on receipt, and repeated after an interval of 10 minutes. They are similarly broadcast by ZBW on 355 metres telephony when the Hong Kong Local typhoon signals are displayed.

V.—WEATHER TELEGRAMS, FORECASTS AND STORM WARNINGS.

Daily Weather Telegrams.—In addition to the ordinary 6h. and 14h. observations, which the Cable Companies transmit free of charge, the 11h. and 17h. observations were received at half rates from the following stations:—

Shanghai	Gutzlaff	Amoy	Macao
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The 2300 and 0700 G.M.T. observations from Fort Bayard, Phu-lien, Tourane, Cape Padaran and Capt St. James, and the 0300 and 0900 G.M.T. observations from the above, and about 12 other stations in Indo-China, are received from Phu-lien on short wave. This service is very valuable and ensures the early receipt of the observations, and at regular hours, namely:—at 0115, 0400, 0830 and 1015 G.M.T. It also saves the expense of obtaining the 0300 and 0900 G.M.T. observations by cable.

Other valuable services are the 2200 G.M.T. observations on 23 metres S.W. from Yangtze Ports, and several stations in N.E. China and Korea sent personally by Father Gherzi S.J. of the Zi Ka Wei Observatory, and the 2100 G.M.T. observations from Pelew, Yap, Saipan and Ponape, sent on 1050 metres from the Pelew Observatory at 0200 G.M.T.

The 0600 and 2200 G.M.T. observations from Hoihow are received by wireless telegraphy occasionally.

The Meteorological Authorities at Pratas continue to send, daily, with commendable regularity and promptitude, their 6h., 11h., 14h. and 17h. observations and the 6h. observations from some Philippine stations. They also send hourly observations during the passage of a typhoon.

Though the number of observations received for constructing daily weather maps has increased of late years, owing to the advent of wireless telegraphy, far more observations are still required before even approximately accurate maps can be drawn, showing kinks in the isobars, lines of discontinuity, cold fronts, warm fronts etc.

Nothing further has been heard of the projected synoptic weather message from a high power wireless station at Hankow, mentioned in last year's report. Nor have any such messages been received from Naha.

At the request of the Director, National Institute of Meteorology, Nankin, watch was kept at 0010 G.M.T. on 1930 January 22 and 23, for the Tokio synoptic weather message, on 4800 metres, but no signals were heard.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hong Kong:—Amoy, Canton, Macao, Phu-lien, Sharp Peak and Taihoku. The Director of the Philippine Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. The 9 p.m. observations from Swatow, kindly sanctioned by the Chinese Telegraph Administration, were received only occasionally; sometimes on the following day. The Director of the Taihoku Observatory sends extra weather telegrams from the two stations in Formosa nearest to the centre during the passage of a typhoon.

Weather Telegrams from Ships by Radio.—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately):—

Month.	<i>British (including H.M. Ships).</i>				<i>Other National- ities.</i>		<i>Total.</i>	
	No. of ships.	No. of messages.	H.M.S. in Port.		No. of ships.	No. of messages.	No. of ships.	No. of messages.
			No. of ships.	No. of messages.				
January,	66	272	19	147	71	107	156	526
February,	61	343	18	105	49	172	128	520
March,	59	163	26	100	66	191	151	454
April,	74	200	13	73	60	140	147	413
May,	49	140	16	103	55	113	120	356
June,	66	173	12	118	74	197	152	488
July,	76	216	8	72	79	222	163	510
August,	67	189	12	87	68	157	147	433
September,	71	283	12	99	60	224	143	606
October,	83	323	32	146	53	171	168	640
November,	57	211	34	141	58	187	149	539
December,	65	136	8	94	55	101	128	331
Totals {	1929,	794	2549	210	1285	748	1982	5816
	1928,	789	2645	203	1202	588	1893	5740
	1927,	544	1802	154	1838	435	1133	5026
	1926,	1058	5216	..	...	831	2376	8883

It will be seen that the number of British ships sending these messages increased from 992 in 1928 to 1004 in 1929. The number of ships of other nationalities increased from 588 to 748.

Results of Weather Forecasts.—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, together with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1924	71	24	5	○
1925	62	34	4	○
1926	72	26	2	○
1927	70	26	4	○
1928	66	31	3	○
1929	70	28	2	○

The forecast comprises wind direction, wind force, and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings.—The symbols of the China Seas Non-local Storm Signal Code are displayed on Kowloon Signal Hill and on the roof of No. 49 Godown of the Hong Kong & Kowloon Wharf and Godown Co.

The following Ports are warned by a telegraphic adaptation of the code:—Shanghai, Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phu-lien, Taihoku, Manila, Labuan and Singapore. 108 storm warnings were sent in 1929. 178 were received from Manila, and 261 from Zikawei. The corresponding numbers in 1928 were 103, 187 and 144 respectively.

The Central Weather Bureau, Poona, was warned on September 6 and 20 and December 11, of the passage of typhoons across Indo-China in a westerly direction.

No alterations in the arrangements for the display and dissemination of local Storm Signals were made during the year.

In the following table are given the number of times and number of hours the local signals were hoisted in each of the years 1925-1929:—

Year.	Red Signals.		Black Signals.		Bombs.
	Number of times.	Number of hours displayed.	Number of times.	Number of hours displayed.	Number of times fired.
1925	5	128	3	57	...
1926	5	50	4	103	1
1927	8	169	4	61	1
1928	1	10	2	58	...
1929	3	28	2	46	1

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signal indicates that a depression or typhoon exists which may possibly cause a gale at Hong Kong within 24 hours. The black signals indicate that a gale is expected at Hong Kong.

Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &C.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 197 ships operating in the Far East. These logs, representing 10,153 days' observations have been utilised for amplifying the weather maps and verifying typhoon tracks. The corresponding figures for the year 1928 were 186 and 9425.

Comparison of Barometers.—The corrections to ships barometers are usually obtained by comparing their readings while at Hong Kong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Observatory Standard.

VII.—MAGNETIC OBSERVATIONS.

From the beginning of 1928 Magnetic horizontal force, declination and dip have been determined at the Au Tau Station weekly, when possible. The instruments used are a magnetometer by Cook, Troughton and Simms, No. 31, and an Earth Inductor by the Cambridge Instrument Co. C65818. In the

following table are given the annual values of the magnetic elements in 1929 as derived from 41 determinations:—

Declination (West)	0.43.5
Dip (North)	30.38.7
Horizontal Force (C.G.S. unit)	0.37481
Vertical Force (C.G.S. unit)	0.22206
Total Force (C.G.S. unit)	0.43565

Photographic registration of the variation of magnetic Declination, Horizontal Force, and Vertical Force was maintained at Au Tau throughout the year, except from May 30th to August 30th, during which period alterations were made in the magnetograph house, with a view to securing greater temperature insulation. During the progress of these alterations the disposition of the registration apparatus and lights of the Declination variometer was rearranged, in order to obtain a greater scale value. It is now 5.53 inches for 1°, in place of 2.80 inches.

The measurement and tabulation of the magnetograms has not been commenced, as the records are not yet satisfactory. The trace of the H.F. variometer has shown a persistent creep throughout the year, in a direction signifying increased moment of the magnet, or decreased torsion couple. As it was thought that the snellae joints of the suspension had possibly become soft and yielding, on account of the high temperature experienced during the summer months, they were replaced by solder. The creep continues however, and further investigation as to its origin is necessary.

The frequent adjustments of the V.F. thermograph on the V.F. variometer, necessary on account of its very open scale value, produced disturbances of the V.F. scale value, and the suspension was eventually broken during one such adjustment, in May, prior to the commencement of the alterations to the building. The suspension was repaired and registration resumed in August, after an arrangement had been fitted whereby adjustments could be effected to the thermograph without opening the instrument case. The V.F. record is not yet satisfactory however, and at the end of the year, experiments were again in progress to determine what scale value should be adopted.

Much difficulty has been experienced in obtaining suitable and sufficiently economical registering lights, which could be fixed with the necessary rigidity; but satisfactory registration is now being obtained with a frosted strip-light lamp in a firmly fixed brass cylindrical cover in which a fine vertical slit is cut. No condenser is necessary with this method.

The Chinese attendant at Au Tau is changing the photographic sheets satisfactorily and keeping the batteries charged, but he cannot cope with emergencies when they arise. It is necessary to send an officer from the Observatory, a distance of 27 miles. This occasionally causes delay in rectifying faults and consequent loss of register.

VIII.—TIME SERVICE.

Time Ball.—The time ball on Kowloon Signal Hill is dropped at 10*h.* and 16*h.* daily, except on Saturdays when it is dropped at 10*h.* and 13*h.* and on Sundays and Holidays when it is dropped at 10*h.* only (120th Meridian Time).

The ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

Time signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. The lights are extinguished momentarily every second from 20*h.* 55*m.* to 21*h.* except at the 28th, 29th, 54th, 56th, 57th, 58th and 59th seconds, of each minute. The 21*h.* signals were repeated at midnight on December 31, the last signal indicating the close of the year 1929. The hours refer to Hong Kong Standard Time (8 hours East of Greenwich).

The Timeball was dropped successfully 658 times. There were two failures, on August 2nd and 4th at 10*h.* a.m. when it fell 12 seconds and 30 seconds early, respectively. The failures were due to electrical defects in the connections within the observatory. The ball was not raised on August 22nd at 4*h.* p.m. owing to a typhoon gale, and on August 24th and 25th at 4*h.* p.m. owing to faults in the exterior lines.

The error of the time ball due to accumulated error of the standard clock never exceeded 0*s.*3 throughout the year.

The probable error of the time ball in each month of the past five years is given in the following table.

Month.	Probable Error of the Time Ball.				
	1925	1926	1927	1928	1929
January,	±0'38	±0'13	±0'14	±0'13	±0'10
February,	'22	'18	'12	'10	'10
March,	'22	'11	'11	'10	'10
April,.....	'16	'13	'10	'10	'10
May,	'11	'10	'14	'10	'10
June,	'10	'10	'13	'20	'10
July,	'10	'10	'10	'11	'10
August,.....	'12	'10	'12	'20	'12
September,	'10	'10	'10	'11	'10
October,	'12	'11	'11	'11	'10
November,	'10	'10	'10	'10	'11
December,.....	'10	'13	'13	'12	'14
Means,	±0'15	±0'12	±0'12	±0'12	±0'11

Time Signals by Radio Telegraphy.—In addition to the time signals given by the time ball, and on the radio mast, signals are broadcast at 10*h.* and 21*h.* by radio-telegraphy, via Cape D'aguiar. Particulars of the programme are given in Government Notification No. 322 of the 1st June, 1928.

Observations of the rhythmic radio time signals emitted by Nauen at 8*h.* a.m., Hong Kong Standard Time, have been made daily, whenever possible, during the year. The observations have been utilized for clock regulation during cloudy weather.

Longitude Determination.—During the period Jan. 1st, 1927—December 31st, 1929, 285 observations of the Bordeaux time signal were observed, giving a longitude of Hong Kong of 7*h.* 36*m.* 41.28*s.* East of Greenwich. During the same period, 916 observations of the Nauen time signal were made, giving a longitude of 7*h.* 36*m.* 41.21*s.* east of Greenwich. The mean result from observations of both stations is therefore 7*h.* 36*m.* 41.25*s.* This result is identical with that obtained by means of 13 simultaneous observations of the Bordeaux time signal observed by Hong Kong and Greenwich in September–November, 1925. Both results need a correction of—0.03*s.* for time of transit of the signal, and as a result of all observations made at the Royal Observatory, Hong Kong, the longitude may be taken as 7*h.* 36*m.* 41.22*s.* east of Greenwich. The 35 observations of the Bordeaux time signal made during October and November 1926 were sent to the “Commission Internationale des Longitudes par T.S.F.” and in “La Revision des Longitudes Mondiales” the resulting longitude of Hong Kong is given as 7*h.* 36*m.* 41.19*s.* east of Greenwich. It is not proposed at present to alter the adopted longitude of the observatory, namely, 7*h.* 36*m.* 41.25*s.* east of Greenwich.

Transit Instrument.—Routine transit and level observations were made by the Chinese computers throughout the year. The Collimation and Azimuth determinations and occasional transit observations were made by the Chief and First Assistants.

The number of observations in the years 1928 and 1929 was as follows:—

	1928	1929
Transits	1200	1111
Level determinations	620	562
Azimuth determinations (mark) ...	31	32
Azimuth determinations (transit of circumpolar stars)	276	271
Collimation determinations (mark)	41	35

Clocks.—Sidereal Clock Cottingham and Mercer, No. 507, has been in use as the Observatory Standard throughout the year. Its performance was again marked by a steady increase of

losing rate (with superposed fluctuations corresponding to variations of pressure in the clock case due to temperature changes) until the end of October, since when the losing rate has shown a distinct tendency to decrease. No increase of pressure due to leakage in the case has been detected. The losing rate varied from $-0s.25$ on February 12 to $+0s.20$ on October 5. Pressure in the clock case was reduced by about 15 m.m. on July 6.

The Leroy Mean Time Clock, No. 1350, was used for dropping the time ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co. and the Eastern Extension Telegraph Co. The clock is corrected daily before 10*h.* and 16*h.* by the electric regulating apparatus. The daily rate of the pendulum is kept below 0.5*s.* by the addition or withdrawal of weights. The Dent Mean Time Clock, No. 39740, is held in readiness as a substitute for Leroy No. 1350. It was not required for this purpose in 1929.

IX.—MISCELLANEOUS.

Seismograph.—No alterations were made to the seismograph during the year. New needle points were fitted as required. As against 183 in 1928, 252 earthquakes were recorded during the year 1929.

The seismograms have been forwarded to the President of the International Seismological Committee, Oxford, to be dealt with.

Upper Air Research.—82 balloon ascents were made during the year, 6 of which were observed with a second theodolite, 6469 feet to the north of the Observatory. 4 temperature flights were made by Officers of the R.A.F. from the Kai Tak base.

The result of the pilot balloon observations have been forwarded monthly to the Secretary of the International Commission for the exploration of the upper air.

The following days were selected by the International Commission as days for international ascents:—April 15-20, August 12-17, and December 17-19. December was chosen as the "International month". Balloon ascents were made on April 15-16. On the other International days the weather was too cloudy.

Rain-making Experiments.—The water shortage having become very serious, on June 18, R.A.F. planes from the R.A.F. base, Kai Tak, dropped $6\frac{1}{2}$ cwt. of powdered kaolin on cumulus cloud, with a view to producing rain.

The experiments were suggested by a Hong Kong resident and were sanctioned by the Naval authorities at the request of the Hong Kong Government, not with any hope of producing rain, but to satisfy the public. The result of the experiments was as anticipated.

Conferences.—The Director attended the Conference of Empire Meteorologists held at London in August, and the International Conference of Directors of Meteorological Services held at Copenhagen in September.

At the conference of Empire Meteorologists it was suggested that a Conference of Directors of Far Eastern Weather Services should be held at an early date to discuss the possibility of adopting:—

- (a) Uniform codes for local and non-local visual storm warning signals for the Far East.
- (b) a uniform code for the transmission in the Far East of daily weather reports by cable.

The suggestion was agreed to and approved by the International Conference of Directors. The Director of the Royal Observatory, Hong Kong, was asked to act as Convener.

New symbols for Local Storm warnings.—Towards the close of the year, the rattan symbols of the Hong Kong Local Storm Signal Code were replaced by others of expanded metal on steel frames, which, though of different design, have the same appearance as the old symbols, at a distance.

Lithographic Work.—Plans of the various schemes for an improved water supply were lithographed at the Observatory in January and special temperature charts for the Kowloon Hospital in February.

Visitors.—Professor Kiyofusa Sotome, Director of the Astronomical Observatory, Tokio, and Professor Gerhard Schott, of the Deutsche Seewarte, visited the Observatory on April 5, Professor R. C. de Ward, of the Blue Hill Observatory, on April 6th. Fathers C. Repetti, from Manila, and E. Gherzi, from Zikawei, on April 30. Professor Pingjan Tsiang, Director of the Tsingtau Observatory, and Professor Coching Chu, Director of the National Institute of Meteorology, Nankin, on May 4. Dr. Wilhelm Credner, of the Sun Yat Sen University, on July 16. Dr. Sekiguti and Dr. Kunitona, delegates from Japan to the International Meteorological Conference, Copenhagen, on December 9th.

Staff.—No change occurred in the European Staff during the year. The Clerical Assistant, Mr. Chan Tin Fuk, was transferred to Volunteer Head Quarters on December 13 and was replaced by Mr. R. P. Ghilote, from the Harbour Department.

The Director was on leave of absence from March 30 to December 4.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows:—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1920	25,965.66	2,515.09	.....
1921	32,700.51	6,734.85	.....
1922	38,350.10	5,649.59	.....
1923	38,522.58	172.48	.....
1924	52,638.49	14,115.91	.....
1925	41,955.51	.....	10,682.9
1926	45,158.87	3,203.36	.....
1927	36,664.99	.....	8,493.88
1928	35,434.52	.....	1,230.47
1929	35,141.07	.....	293.45

Acknowledgements.—Acknowledgements are here made to the Naval Authorities for their co-operation in securing daily observations from H. M. ships and upper air temperatures in aeroplanes, to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs Authorities, for daily observations by cable and radio-telegraphy, and extra observations during typhoon weather, to the Telegraph Companies for transmitting the majority of the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio-telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties, particularly to Mr. Jeffries, who had charge of the Observatory in my absence, and to Mr. Evans who acted as Chief Assistant. A considerable amount of extra work was thrown on both.

T. F. CLAXTON,
Director.

19th February, 1930.

1930
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REPORT OF THE DIRECTOR
OF THE ROYAL OBSERVATORY, HONG KONG,
FOR THE YEAR 1930.

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1.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the Observatory coolies.

Magnetic Station at Au Tau.—The daily range of temperature in the magnetograph house is too great for satisfactory registration of magnetic horizontal force and vertical force. Temperature control apparatus to reduce this range has been ordered from England.

Underground Chamber for Scismographs and Clocks.—The range of temperature in the Underground Chamber was $11^{\circ}.6$ (F) in 1930, as against $9^{\circ}.7$ (F) in 1929 and $10^{\circ}.7$ (F) in 1928. The relative humidity was usually above 95% between April 18 and September 2. The absolute range during the year was 46% in 1930, as against 45% in 1929 and 45% in 1928.

In the following table the mean monthly temperature and humidity in the Underground Chamber are compared with the temperature and humidity in the Open Air.

*Mean Monthly Temperature and Relative Humidity in the
Underground Chamber and in the Open Air
during the year 1930.*

Month 1930.	In Underground Chamber.		In the Open Air.		Excess of Under- ground Chamber over Open Air.	
	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity
	°	%	°	%	°	%
January, ..	70.8	81	54.6	75	+ 16.2	+ 6
February, ..	68.5	84	60.3	76	+ 8.2	+ 8
March,	69.6	84	63.9	76	+ 5.7	+ 8
April,	74.1	94	73.5	87	+ 0.6	+ 7
May,	75.4	96	79.2	82	— 3.8	+ 14
June,	77.5	96	81.9	81	— 4.4	+ 15
July,	79.2	96	82.3	83	— 3.1	+ 13
August, ...	80.1	95	82.1	82	— 2.0	+ 13
September	79.8	92	79.4	82	+ 0.4	+ 10
October, ..	78.6	83	76.8	73	+ 1.8	+ 10
November,	77.8	85	70.7	70	+ 7.1	+ 15
December,	75.4	78	64.0	75	+ 11.4	+ 3
Range,	11.6	...	27.7	...	...

II.—METEOROLOGICAL INSTRUMENTS.

All the meteorological instruments were maintained in good order throughout the year.

The thermometers in use were compared with Kew Standard No. 647 in summer and winter.

The working of the electric hammer on the Nakamura Pluviograph was tested daily at 11h.

The Beckley and Dines Baxendell Anemographs were oiled and the orientation of the vanes was checked once a month. The Dines Baxendell instrument continues to work satisfactorily, except at very low velocities when its action is uncertain.

The bearings and helix of the Beckley Anemograph were renewed in July.

The mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1929 are given in the following table, together with the results for 1930:—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor (Dines $\div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1929.	1930.
January,	1'95	2'07
February,	2'00	2'16
March,	2'06	2'15
April,	2'08	2'26
May,	2'19	2'23
June,	2'12	2'26
July,	2'24	2'30
August,	2'23	2'23
September,	2'21	2'23
October,	2'13	2'14
November,	2'03	2'14
December,	1'95	2'08
Year.....	2'10	2'19

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet-bulb thermograph, and the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura Pluviograph and the amount of sunshine by two Campbell-Stokes universal sunshine recorders. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hong Kong Standard Time and of terrestrial radiation at midnight and at 6 a.m. (from 1930, January 1). The character and direction of motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers. Observations of pilot balloons are made with a Watts $1\frac{1}{4}$ inch "Coudé" theodolite at about 9h a.m. and 3h. p.m. except when the base of the clouds is lower than Victoria Peak (1800 ft.)

Principal features of the Weather in 1930:—The principal features of the weather in 1930 were:—

- (a) A typhoon which passed about 50 miles to the S. W. of Hong Kong in the evening of July 24 on a N. N. W. track, producing a strong gale at Hong Kong.
- (b) abnormally low barometer in July.
- (c) abnormally low temperature in January.
- (d) abnormally low humidity in March.
- (e) abnormally high pressure, heavy rain, high wind velocity, with moderately low temperature, in September.

Barometric pressure was considerably above normal in June, September and November, and very considerably below normal in July. The mean pressure for the year at station level (109 feet above sea-level) was 29.850 ins., as against 29.845 ins. in 1929 and 29.842 ins. for the past 47 years. The highest pressure was 30.340 ins. at 9h.45m. a.m. on December 24, as against 30.282 ins. in 1929 and 30.509 ins. for the past 47 years. The lowest pressure was 29.175 ins. at 5.30 p.m. on July 24, as against 28.912 ins. in 1929 and 28.590 ins. for the past 47 years.

The temperature of the air was very considerably below normal (the lowest on record) in January, considerably above in April, moderately above in February, May, November and December, and moderately below in September. The mean temperature for the year was 72°.4, as against 72°.6 in 1929 and 71°.9 for the past 47 years. The highest temperature was 92°.9 at 0h.40m p.m. on July 1, as against 92°.2 in 1929 and 97°.0 for the past 47 years. The lowest temperature was 41°.2 at 7.10 a.m. on January 8, as against 44°.4 in 1929 and 32°.0 for the past 47 years.

The total rainfall for the year was 96.08 inches, as against 69.82 inches in 1929 and 85.61 inches for the past 47 years. From October 1 to the end of the year only 1.33 inch of rain fell. Heavy rain in September, to the extent of 28.24 inches, probably saved the Colony from another water famine. There was a considerable shortage from April to June and in August. The greatest fall in one civil day was 7.96 inches on September 17, as against 7.15 inches in 1929 and 21.02 inches for the past 47 years. The greatest fall in one hour was 2.36 inches between 8½h. and 9½h. a.m. on August 9, as against 2.73 inch in 1929 and 3.96 inches for the past 47 years.

The wind velocity was considerably below normal from January to March and also in August and October. It was moderately above in September. The mean velocity for the year was 10.9 m.p.h., as against 11.6 m.p.h. in 1929 and 12.4 m.p.h. for the past 47 years. The maximum velocity for one

hour, as recorded by the Beckley anemograph was 66 m.p.h. at 7 p.m. on July 24, as against 89 miles in 1929 and 108 miles for the past 47 years. The maximum gust velocity, as recorded by the Dines-Baxendell anemograph, was at the rate of 83 m.p.h. from E.S.E. at 9.23 p.m. on July 24, as against 117 m.p.h. in 1929 and 130 m.p.h. for the past 21 years.

The relative humidity was considerably below normal in March, considerably above in December, and moderately above in September. The mean for the year was 78%, as June, and August. The mean for the year was 78%, as against 77% in 1929 and 78% for the past 47 years. It frequently exceeded 95% in spring and summer. The lowest for the year was 29% at 0h. 45m. p.m. on March 13, as against 26% in 1929 and 12% for the past 47 years.

Rainfall at six Stations.—In the following table the monthly rainfall for the year 1930 at the Observatory is compared with the fall at the Police Station (Tai Po), the Botanical Gardens (Hong Kong), The Matilda Hospital (Mount Kellet), Fanling and Naval Hospital.

Month.	Observatory (Kowloon).	(Police Station Tai po).	Botanical Gardens (Hong Kong).	Matilda Hospital (Mount Kellet, Hong Kong).	Fanling.	Naval Hospital.
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January, ...	2.275	2.38	2.43	1.85	2.28	2.00
February, .	1.380	2.14	1.51	1.31	2.15	1.09
March,	7.230	10.11	7.15	7.53	6.09	5.27
April,	2.100	2.80	2.26	1.82	2.42	2.04
May,	6.185	4.62	7.99	7.42	6.04	7.29
June,	12.245	11.90	15.00	9.91	9.06	15.35
July,	29.025	24.57	31.51	26.30	28.63	25.89
August, ...	6.065	4.82	5.22	5.90	5.46	3.86
September, .	28.245	32.56	29.40	33.30	24.05	30.50
October,	0.410	0.27	0.02	0.03	0.51	0.31
November, .	0.035	0.26	0.07	0.01	0.40	0.02
December, .	0.890	1.45	1.23	1.21	1.56	1.16
Year...	96.085	97.88	103.79	96.59	88.65	94.78

Floods.—Land slides were caused by heavy rains on July 15.20 and September 14 to 25.

A water spout occurred at Cape d'Aguiar on September 29, after a typhoon had passed about 200 miles south and west of Hong Kong. A report on the phenomenon, furnished by the officer in charge of the station (Mr. J. Key) was forwarded to the Editor of the Meteorological Magazine, London.

The heaviest rainfall occurred at the Observatory as follows:—

<i>Period</i> <i>1930.</i>				<i>Amount.</i>	<i>Duration.</i>	<i>Greatest fall</i> <i>in 1 hour.</i>					
						<hr/>					
						<i>Amount.</i>	<i>Time.</i>				
d.	h.		d.	h.	inches.	hours.	inches.	d.	h.		
May	8	1	to	12	1	4.84	35	2.12	May ...	8	11
June	4	8	to	10	16	9.10	48	1.33	June ...	5	12
July	14	8	to	21	0	14.68	57	1.34	July ...	19	21
July	24	1	to	25	13	9.20	28	0.87	July ...	25	9
Aug.	21	9	to	21	18	3.53	10	2.36	Aug. ...	21	9
Sept.	14	6	to	18	7	21.04	86	1.22	Sept. ...	17	22
Sept.	28	0	to	28	13	4.32	9	2.24	Sept. ...	28	11

Typhoons.—The tracks of 19 typhoons which occurred in the Far East during the year 1930 are given in the Monthly Meteorological Bulletin for December. On July 24 a typhoon passed about 50 miles to the S.W. of Hong Kong on a N.N.W. track, producing a strong gale at the Observatory. The maximum gust velocity was at the rate of 83 m.p.h. from E.S.E. at 9h.23m.p.m. The lowest barometer reading, reduced to sea-level and standard gravity, was 29.288 inches at 5.30 p.m.

IV.—PUBLICATIONS.

Daily Weather Report and Map.—A weather map of the Far East, for 6 a.m. of the 120 meridian time, is constructed daily and lithographed at the Observatory. Isotherms have been included since March 6. On the verso of the map is printed the morning weather report, from 40 to 50 stations in China, Indo-China, Japan, Korea, Borneo and the Philippines, and a weather forecast for the following districts:—

1. Formosa Channel.
2. S.E. Coast of China between Hong Kong and Lamocks.
3. Hong Kong to Gap Rock.
4. S. Coast of China between Hong Kong and Hainan.

This publication is exhibited on notice boards at the Hong Kong and Kowloon Ferry Piers, the Harbour Office, at the offices of the Cable Companies and at the General Post Office. It may be purchased by the general public at a subscription rate of \$10 per annum. During the year 47 companies etc. subscribed for 57 copies. The weather report and forecast, and all storm warnings, are telephoned to Stonecutters Wireless Station for transmission to H.M. ships on the China Station.

A weather map for 2 p.m. of the 120th. meridian time is also constructed daily. It is not published, but an evening weather report, and forecast based thereon, is sent to the morning papers and exhibited on the notice boards.

Meteorological observations made at the Observatory at 10 a.m. and 4 p.m. are published in the local press.

Meteorological observations from 26 stations in the Far East, followed by a weather report and forecast, are broadcast by Cape d'Aguilar (VPS) on a 600 metre spark at 0400 and 1200 G.M.T. A repetition of the 0400 message is made by VPS on 2913 metres I.C.W. at 0500 and the 1200 message on 2913 metres I.C.W. immediately following the 1300 time-signal.

The weather reports and forecasts are also broadcast by the Hong Kong Broadcasting station (ZBW) on 355 metres telephony at 0530 and 1300 G.M.T.

Hong Kong storm warnings are broadcast by VPS on a 600 metre spark and by ZBW on 355 metres telephony on receipt and at the two subsequent hours. They are also broadcast as above at every hour when the typhoon is threatening Hong Kong.

Shanghai and Manila warnings are broadcast by VPS on a 600 metre spark on receipt, and repeated after an interval of 10 minutes. They are similarly broadcast by ZBW on 355 metres telephony when the Hong Kong local typhoon signals are displayed.

V.—WEATHER TELEGRAMS, FORECASTS AND STORM WARNINGS.

Daily Weather Telegrams.—In addition to the ordinary 6h. and 14h. observations, which the Cable Companies transmit free of charge, the 11h. and 17h. observations were received at half rates from the following stations:—

Shanghai

Gutzlaff

Amoy

Macao

The 0700 and 2300 G.M.T. observations from Fort Bayard, Phu-lien, Tourane, Cape Padaran and Cape St. James, and the 0300 and 0900 G.M.T. observations from the above, and about 12 other stations in Indo-China, are received from Phu-lien on short wave. This service is very valuable and ensures the early receipt of the observations, and at regular hours, namely:—at 0115, 0400, 0830 and 1015 G.M.T. It also saves the expense of obtaining the 0300 and 0900 G.M.T. observations by cable.

Other valuable services are the 0600 and 2200 G.M.T. observations on 23 metres S.W. from Yangtze Ports, and several stations in N.E. China and Korea sent personally by Father Gherzi, S.J. of the Zi Ka Wei Observatory, and the 2100 G.M.T. observations from Pelew, Yap, Saipan and Ponape, sent on 1050 metres from the Pelew Observatory at 0200 G.M.T.

Valuable observations from Woody Island, Paracels, were received from May 27 to June 11. The 0600 and 2200 G.M.T. observations from Hoihow are received by wireless telegraphy occasionally.

The Meteorological Authorities at Pratas continue to send, daily, with commendable regularity and promptitude, their 0300, 0600, 0900 and 2200 G.M.T. observations and the 2200 observations from some Philippine stations. They also send hourly observations during the passage of a typhoon.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hong Kong:—Amoy, Canton, Macao, Phu-lien, Sharp Peak and Taihoku. The Director of the Philippine Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. On request, the Director of the Taihoku Observatory sends extra weather telegrams from the two stations in Formosa nearest to the centre during the passage of a typhoon.

Weather Telegrams from Ships by Radio.—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number

of messages received (each arrival and departure is counted separately):—

Month.	British (including H.M. Ships).				Other National- ities.		Total.		
	No. of ships.	No. of mes- sages.	H.M.S. in Port.		No. of ships.	No. of messages.	No. of ships.	No. of messages.	
			No. of ships.	No. of messages.					
January,	86	146	21	132	54	98	161	376	
February,	65	115	25	160	47	77	137	352	
March,.....	82	151	19	126	54	96	155	373	
April,	90	160	11	86	46	78	147	324	
May,	139	216	29	166	69	123	237	505	
June,	126	233	54	760	46	101	226	1094	
July,	175	405	38	1063	80	143	293	1611	
August,	176	419	46	844	46	74	268	1337	
September,	154	376	45	1256	75	141	274	1773	
October,	156	318	48	1306	56	94	260	1718	
November,	160	358	45	1323	67	110	272	1791	
December,	106	220	33	1242	55	99	194	1561	
Totals {	1930,	1515	3117	414	8464	695	1234	2624	12815
	1929,	794	2549	210	1285	748	1982	1752	5816
	1928,	789	2645	203	1202	588	1893	1580	5740
	1927,	544	1802	154	1838	435	1386	1133	5026

It will be seen that the number of British ships sending these messages increased from 1004 in 1929 to 1929 in 1930. This was due to a welcome increase in the meteorological activities of the Navy. The number of ships of other nationalities decreased from 748 to 695.

Results of Weather Forecasts.—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, together with the results for the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1925	62	34	4	0
1926	72	26	2	0
1927	70	26	4	0
1928	66	31	3	0
1929	70	28	2	0
1930	65	31	4	0

The forecast comprises wind direction, wind force, and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

The method of analysis is described in the 1918 Report.

Storm Warnings.—The symbols of the China Seas Non-local Storm Signal Code are displayed on Kowloon Signal Hill and on the roof of No. 49 Godown of the Hong Kong & Kowloon Wharf & Godown Co.

The following Ports are warned by a telegraphic adaptation of the code:—Shanghai, Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phu-lien, Taihoku, Manila, Labuan and Singapore. 111 storm warnings were sent in 1930. 113 were received from Manila, and 209 from Zikawei. The corresponding numbers in 1929 were 108, 178 and 261 respectively.

No occasion arose to warn the Central Weather Bureau, Poona, of the passage of typhoons across Indo-China in a westerly direction.

No alterations in the arrangements for the display and dissemination of local Storm Signals were made during the year.

In the following table are given the number of times and number of hours the local signals were hoisted in each of the years 1926-1930.

Year.	Red Signals.		Black Signals.		Bombs.
	Number of times.	Number of hours displayed.	Number of times.	Number of hours displayed.	Number of times fired.
1926	5	50	4	103	1
1927	8	169	4	61	1
1928	1	10	2	58	...
1929	3	28	2	46	1
1930	5	88	3	37	...

The figures in the above table include the number of hours that night signals, corresponding to the day signals, were hoisted.

The red signal indicates that a depression or typhoon exists which may possible cause a gale at Hong Kong within 24 hours. The black signals indicate that a gale is expected at Hong Kong.

Three bombs fired at intervals of 10 seconds indicate that wind of typhoon force is anticipated.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS. TREATY PORTS, ETC.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 192 ships operating in the Far East. These logs, representing 10,273 days observations have been utilised for amplifying the weather maps and verifying typhoon tracks. The corresponding figures for the 1929 were 197 and 10,153.

Comparison of Barometers.—The corrections to ships barometers are usually obtained by comparing their readings while at Hong Kong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Standard.

VII.—MAGNETIC OBSERVATIONS.

From the beginning of 1928 magnetic horizontal force, declination and dip have been determined at the Au Tau Station weekly, when possible. The instruments used are a magnetometer by Cook, Troughton & Simms, No. 31, and an earth inductor by the Cambridge Instrument Co. C65818. In the following

table are given the annual values of the magnetic elements in 1930 as derived from 52 determinations:—

Declination (West)	0.43.6
Dip (North)	30.37.3
Horizontal Force (C. G. S. Unit)	0.37485
Vertical Force (C. G. S. Unit)	0.22187
Total Force (C. G. S. Unit)	0.43559

Photographic registration of magnetic declination, horizontal force and vertical force was maintained throughout the year, except during periods of adjustment. The correct interpretation of the records is doubtful, however, owing to the difficulty of determining the temperature co-efficients of the force variometers accurately, and the instability of the declination base-line. A new mirror for the latter is on order from England, and it is hoped that abnormalities will disappear after its installation.

The records show that the temperature co-efficients of the horizontal and vertical force variometers are considerable, and pending the installation of an efficient temperature regulator, experiments with a control magnet for the horizontal force variometer are in progress.

The following table gives temperature data for the magnetograph room during the year 1930.

Month.	Temperature.			Daily Range.		
	Absolute.		Mean.	Absolute.		Mean.
	Maximum.	Minimum.		Maximum.	Minimum.	
	°	°	°	°	°	°
January,	67.6	54.7	58.9	2.9	0.7	1.3
February,	74.5	54.8	62.8	2.6	0.4	1.6
March,	75.6	60.9	67.8	4.3	0.1	1.5
April,	83.2	92.1	78.6	2.5	0.7	1.4
May,	87.6	82.0	84.5	2.5	0.8	1.4
June,	91.5	81.7	87.4	2.6	1.0	1.7
July,	91.6	84.0	88.0	2.3	0.8	1.4
August,	92.5	84.3	89.0	2.3	1.0	1.5
September, ...	92.0	81.1	85.3	1.8	0.5	1.2
October,	85.4	79.9	82.7	2.3	0.9	1.6
November,	84.3	74.3	76.5	3.3	1.0	1.6
December, ...	76.6	64.7	70.3	3.7	0.7	1.5

The following table shows the magnetic character of the year 1930, at Hong Kong.

Month Day.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0	1	1	1	0	1	1	0	1	0	1	0
2	0	0	1	0	0	1	1	0	1	0	1	0
3	1	1	1	0	0	1	1	0	1	1	0	2
4	1	1	1	0	1	1	1	0	1	1	1	1
5	1	1	0	0	1	0	1	1	1	1	0	0
6	1	0	0	1	1	0	1	1	1	1	0	0
7	1	1	0	1	1	1	0	1	1	0	0	1
8	1	0	0	1	1	1	0	1	0	0	0	0
9	0	0	0	1	1	1	1	1	1	0	0	0
10	0	0	0	1	0	0	1	1	0	0	0	0
11	0	0	1	1	0	0	1	1	1	0	0	0
12	0	1	2	1	1	1	1	1	0	0	0	1
13	1	1	1	1	1	1	1	1	0	0	1	1
14	0	1	1	0	0	1	0	0	0	1	1	1
15	0	1	1	1	0	0	1	1	0	0	1	0
16	0	1	1	1	1	2	1	1	0	0	0	0
17	1	1	1	1	1	1	1	0	1	1	0	0
18	0	1	1	1	1	1	1	0	2	1	0	0
19	0	1	1	1	1	1	0	1	1	1	0	1
20	1	1	0	2	1	1	0	0	0	1	0	1
21	1	0	1	1	1	1	1	1	1	0	0	2
22	1	0	1	1	1	0	0	1	0	1	0	1
23	0	1	1	1	0	0	1	1	1	0	1	1
24	0	0	1	1	0	0	1	1	1	0	1	0
25	0	1	1	0	1	0	1	0	0	1	1	0
26	0	1	1	1	1	0	1	0	0	1	1	0
27	0	1	1	0	0	1	1	0	0	1	1	1
28	0	1	1	0	0	1	1	0	1	1	0	0
29	0	...	1	0	0	1	1	0	1	1	0	1
30	1	...	0	1	1	0	1	0	1	1	0	0
31	0	...	0	...	1	...	0	0	...	1	...	0

0=calm.

1=disturbed.

2=very disturbed.

VIII.—TIME SERVICE.

Time Ball.—The time ball on Kowloon Signal Hill is dropped at 10h. and 16h. daily, except on Saturdays when it is dropped at 10h. and 13h. and on Sundays and Holidays when it is dropped at 10h. only (120th Meridian Time).

The ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

Time signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. The lights are extinguished momentarily every second from 20h. 55m. to 21h. except at the 28th, 29th, 54th, 56th, 57th, 58th and 59th seconds, of each minute. The 21h. signals were repeated at midnight on December 31, the last signal indicating the close of the year 1930. The hours refer to Hong Kong Standard Time (8 hours east of Greenwich).

The timeball was dropped successfully 661 times. There was one failure, on September 4 at 16h, when the ball fell about 2½ minutes before 16h, owing to the accidental discharge of the lock from the Observatory. The winding apparatus was damaged considerably, but repairs were expeditiously effected by Messrs. W. S. Bailey & Co. the apparatus being again in action on Sept. 7. The ball was not raised on Dec. 6 at 13h. and Dec. 7. at 10h. owing to electrical defects.

The error of the timeball was 0s.4 three times, 0s.5 twice, and 0s.9 once. On all other occasions the ball fell with an error of 0s.3 or less.

The probable error of the time ball in each month of the past five years is given in the following table.

Month.	Probable Error of the Time Ball.				
	1926	1927	1928	1929	1930
January,	±0°13	±0°14	±0°13	±0°10	±0°10
February,	°18	°12	°10	°10	°13
March,	°11	°11	°10	°10	°12
April,	°13	°10	°10	°10	°16
May,	°10	°14	°10	°10	°15
June,	°10	°13	°20	°10	°14
July,	°10	°10	°11	°10	°10
August,	°10	°12	°20	°12	°12
September,	°10	°10	°11	°10	°10
October,	°11	°11	°11	°10	°11
November,	°10	°10	°10	°11	°10
December,	°13	°13	°12	°14	°10
Means,	±0°12	±0°12	±0°12	±0°11	±0°12

Time Signals by Radio Telegraphy.—In addition to the time signals given by the time ball, and on the radio mast, signals are broadcast at 10h. and 21h. by radio-telegraphy, via Cape d'Aguilar. Particulars of the programme are given in Government Notification No. 322 of the 1st June, 1928.

Observations of the rhythmic radio time signals emitted by Nauen at 8h. a.m. Hong Kong Standard Time, have been made daily, whenever possible, during the year. The observations have been utilised for clock regulation during cloudy weather.

Transit Instrument.—Routine transit and level observations were made by the Chinese computers throughout the year. The Collimation and Azimuth determinations, and occasional transit observations, were made by the Chief and First Assistants.

The number of observations in the years 1929 and 1930 was as follows:—

	1929	1930
Transits	1111	1078
Level determinations	562	546
Azimuth determinations (mark) ...	32	42
Azimuth determinations (transit of circumpolar stars)	271	238
Collimation determinations (mark)	35	47

Clocks.—Sidereal Clock, Cottingham and Mercer, No. 507, has been in use as the Observatory Standard throughout the year. Its performance was again marked by a steady increase of losing rate (with superposed fluctuations corresponding to variations of pressure in the clock case, due to temperature changes). This is probably due to an increase of about one inch of barometric pressure within the clock case, caused by gradual leakage during the year. The losing rate of the clock varied from—0s.28 on Feb. 18 to + 0s.55 on Dec., 11.

The Leroy Mean Time Clock, No. 1350, was used for dropping the time ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co. and the Eastern Extension Telegraph Co. The clock is corrected daily before 10h. and 16h. by the electric regulating apparatus. The daily rate of the pendulum is kept below 0.5s by the addition or withdrawal of weights. The Dent Mean Time Clock, No. 39740, is held in readiness as a substitute for Leroy No. 1350. It was not required for this purpose in 1930.

IX.—MISCELLANEOUS.

Seismograph.—No alterations were made to the seismograph during the year. New needle points were fitted as required. 320 earthquakes were recorded during the year 1930 as against 252 in 1929.

The seismograms have been forwarded to the President of the International Seismological Committee, Oxford, to be dealt with.

Upper Air Research.—325 balloon ascents were made during the year. 34 meteorological flights were made by officers of the R.A.F. before the departure of the carrier, H.M.S. Hermes, on July 28.

The results of the pilot balloon observations have been forwarded monthly to the Secretary of the International Commission for the exploration of the upper air.

The following days were selected by the International Commission as days for international ascents:—January 13-18, May 13-15 and September 15-20. September was chosen as the "International month". Balloon ascents were made on January 13-14, May 13-15 and September 15, 19, and 20.

Special ascents were made at 8.30 a.m. on March 12-14 in connection with R.A.F. bombing practice.

Communication with Stonecutters.—Direct telegraphic communication between the Observatory and Stonecutters Wireless Station was restored on February 18. Communication had been by telephone only since 1927, October. For the accurate transmission of weather telegrams telegraphic tape machines are essential.

Course in Meteorology.—Lieut. A. St. J. Edwards, R.N., H.M.S. Hermes, Assistant to Senior Observer, took a course in meteorology at the Observatory from February 24 to March 23.

Short wave experimental emissions.—Watch was kept at the Observatory Wireless Station for the short wave experimental emissions from Paris and Lyons on January 11-18, May 31, June 7, 14, 21, 28, November 22, 29, December 6, 13.

The signals of the first two series were heard at varying strengths, but those of the third series were not heard at Hong Kong.

Lithographic Work.—The following lithographic work was done at the Observatory for other departments:—

- (a) 6 plans accompanying the Report of the Playing Fields Committee.
- (b) Map of Hong Kong and New Territories for Dominions and Colonial Office List.
- (c) Map of Hong Kong Stone Quarries.
- (d) 6 plans accompanying Report on Shing Mun Water supply scheme.
- (e) Plan of arrangements for Armistice Day celebrations.

Conferences:—The Director attended a Conference held at the Observatory from January 22-24 to consider the meteorological needs of the Navy. Commander E. W. Kitson, R.N. presided, the details and agenda having been planned by Commander L. G. Garbett, R.N. (Retired) Superintendent of the Navy Services Division, Meteorological Office, London, who came to Hong Kong to attend the Conference.

The recommendations of the Conference, when carried out, should do much to improve the Hong Kong and Malaya Weather Services and prove of great benefit to H.M. Ships on the China Station.

A Conference of Directors of Far Eastern Weather Services was held in the Council Chamber from April 28 to May 2, in accordance with a resolution passed at the International Conference of Directors of Weather Services held at Copenhagen in 1929.

The object of the conference was to secure uniformity throughout the Far East in:—

- (a) The codes used for local and non-local visual storm warnings.
- (b) The code used for transmitting daily weather Reports by cable.

The conference was attended by representatives from the following Weather Services:—

Hong Kong
Indo-China
Nanking
Philippines
Pratas
Tsingtao
Zi-ka-wei

The Conference recommended that the Hong Kong Code of Local Storm Signals, as amended at the Conference, should be adopted by Weather Services in the Far East which use a Local Storm Signal, and that the China Seas Storm Signal Code, as revised by the Director of the Royal Observatory, Hong Kong, and amended at the Conference, be adopted by Weather Services in the Far East which use a Non-Local Storm Signal Code. The Conference also recommended that the Six-letter Code for transmission of weather telegrams by cable proposed by the Director of the Royal Observatory, Hong Kong, as amended at the Conference, should be adopted throughout the Far East.

A report on the Conference, including 13 other resolutions adopted, has been printed and circulated to the principal observatories of the world.

Visitors.—Lieut.-Comdr. H. Huang, C.N. who relieved Lieut.-Comdr. Y. C. Shen as Director of the Pratas Meteorological Station, visited the Observatory on March 29, prior to sailing for Pratas. Commodore R. A. S. Hill, R.N. with Comdrs. Maxwell and Law, on March 31. Lieut.-Comdr. Y. C. Shen, Director of the Pratas Meteorological Station on April 9, *en route* from Pratas to Shanghai. Brig-General Winterbotham, on a tour of Empire Survey inspection, on April 17. Captain Plexton, Commander of the Revenue cutter *Pingching*, on July 12, *en route* to Pratas.

Parties of students from St. Stephen's Girls School visited the Observatory on March 12 and 19, from Middle Light School, Canton, on April 15, from the Chu Chih Hsien Memorial School on April 21, and from the Chinese Y.M.C.A. on October 30.

Staff.—No change occurred in the European or local staff during the year.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows:—

Year.	Total Expenditure.	Increase.	Decrease.
	\$ c.	\$ c.	\$ c.
1921	32,700.51	6,734.85	.....
1922	38,350.10	5,649.59	.....
1923	38,522.58	172.48	.....
1924	52,638.49	14,115.91	.....
1925	41,955.51	.....	10,682.98
1926	45,158.87	3,203.36	.....
1927	36,664.99	.....	8,493.88
1928	35,434.52	.....	1,230.47
1929	35,141.07	.....	293.45
1930	54,133.40	18,992.33	.....

Acknowledgements.—Acknowledgements are here made to the Naval Authorities for their co-operation in securing daily observations from H.M. Ships and for meteorological flights by officers of the R.A.F., to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs Authorities, for daily observations by cable and radio-telegraphy, and extra observations during typhoon weather, to the Telegraph Companies for transmitting the majority of the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio-telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library and to the Observatory staff for the efficient manner in which they have carried out their respective duties.

T. F. CLAXTON,
Director

January, 26, 1930.

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REPORT OF THE DIRECTOR
OF THE ROYAL OBSERVATORY, HONG KONG,
FOR THE YEAR 1931.

I.—GROUNDS AND BUILDINGS.

1. The grounds were kept in order by the Forestry Department, with the assistance of the Observatory coolies. Small repairs to Buildings were carried out by the Public Works Department.

2. *Magnetic Station at Au Tau.*—Apparatus for controlling the range of temperature in the magnetograph house has been received from England, and will be installed when power is available from the mains of the China Light and Power Co. It is promised in the summer of 1932.

3. *Underground Chamber for Scismographs and Clocks.*—The range of temperature in the Underground Chamber was $10^{\circ}.3$ (F) in 1931, as against $11^{\circ}.6$ (F) in 1930 and $9^{\circ}.7$ (F) in 1929. The relative humidity was usually above 95% between April 18 and September 2. The absolute range during the year was 38% in 1931, as against 46% in 1930 and 45% in 1929.

4. In the following table the mean monthly temperature and humidity in the Underground Chamber are compared with the temperature and humidity in the Open Air:

*Mean Monthly Temperature and Relative Humidity in
the Underground Chamber and in the Open Air
during the year 1931.*

Month	In Underground Chamber.		In the Open Air.		Excess of Under- ground Chamber over Open Air.	
	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity	Temper- ature	Relative Humidity
	°	%	°	%	°	%
January, ..	73·2	83	61·4	75	+ 11·8	+ 8
February, ..	71·7	78	61·3	85	+ 10·4	- 7
March,	70·1	80	63·6	80	+ 6·5	0
April,	71·7	91	70·9	87	+ 0·8	+ 4
May,	74·2	95	77·0	87	- 2·8	+ 8
June,	76·8	96	81·4	82	- 4·6	+ 14
July,	78·7	96	82·7	81	- 4·0	+ 15
August, ...	79·5	95	82·7	83	- 3·2	+ 12
September	80·4	93	81·2	81	- 0·8	+ 12
October, ..	79·2	81	74·4	67	+ 4·8	+ 14
November, ..	77·2	79	70·4	66	+ 6·8	+ 13
December, ..	74·5	78	63·3	72	+ 11·2	+ 6
Range, ..	10·3	...	21·4	...	...	...

II.—METEOROLOGICAL INSTRUMENTS.

5. All the meteorological instruments were maintained in good order throughout the year.

6. The thermometers in use were compared with Kew Standard No. 647 in summer and winter.

7. The working of the electric hammer on the Nakamura Pluviograph was tested daily at 11h.

8. The Beckley and Dines Baxendell Anemographs were oiled and the orientation of the vanes was checked once a month. The Dines Baxendell instrument continues to work satisfactorily, except at very low velocities when its action is uncertain. The mounting of the Dines instrument, which had become badly corroded, was replaced by the P.W.D. in August. The scale value was tested on October 30 and November 3. In the following table the results are compared with those obtained in 1927,

Scale value of Dines Anemograph.

Miles.	Millimetres on sheet.	
	1927	1931
1	0·8	0·6
2	1·5	1·3
3	2·4	2·1
4	3·4	3·1
5	4·5	4·3
6	5·6	5·6
7	6·8	7·0
8	8·1	8·5
9	9·5	10·1
10	11·0	11·8
20	26·1	26·8
40	56·2	56·8
60	86·4	86·9
80	116·5	116·9
100	146·6	147·0
120	176·7	177·0

In determining the scale value for velocity up to 10 *m.p.h.* the U tube was tilted about 80° from the vertical, to obtain sufficient change in the water level for a given velocity.

The mean monthly results of comparisons with the records of the Beckley Anemograph from 1910-1930 are given in the following table, together with the results for 1931:—

Factor for converting the actual run of the Beckley Anemograph cups to velocities recorded by the Dines Pressure Tube Anemograph.

Month.	Factor ($\text{Dines} \div \frac{\text{Beckley}}{3}$).	
	Mean 1910-1930.	1931.
January,	1'96	2'08
February,	2'00	2'08
March,	2'06	2'16
April,	2'09	2'17
May,	2'19	2'20
June,	2'12	2'15
July,	2'24	2'14
August,	2'23	2'28
September,	2'21	2'29
October,	2'13	2'23
November,	2'03	2'19
December,	1'95	2'20
Year.....	2'10	2'18

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

9. Automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet-bulb thermometer, and the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the report for 1912. The amount of rain is recorded automatically by a Nakamura Pluviograph and the amount of sunshine by two Campbell-Stokes universal sunshine recorders. Eye observations of barometric pressure, temperature of the air and of evaporation and the amount of cloud are made at each hour of Hong Kong Standard Time, and of terrestrial radiation at midnight and at 6 a.m. (from 1930, January 1). The character and direction of motion of the clouds are observed every three hours. Daily readings are taken of self-registering maximum and minimum thermometers. Observations of pilot balloons are made with a Watts $1\frac{1}{4}$ inch "Coudé" theodolite at about 9h. a.m. and 3h. p.m., except when the base of the clouds is lower than Victoria Peak (1800 ft.)

10. *Principal features of the Weather in 1931*:—The principal features of the weather in 1931 were:—

- (a) Typhoons passing near the Observatory on August 1, August 17 and September 2, respectively.

- (b) Barometer abnormally high in July and abnormally low in August.
- (c) Rain to the extent of 3.48 inches on December 9, the middle of the dry season.
- (d) Wind velocity abnormally low in July, abnormally high in August, and steadily above normal from March to June.

11. Barometric pressure was considerably below normal in February and very considerably below in August (the lowest on record). It was considerably above in July. The mean pressure for the year at station level (109 feet above sea-level) was 29.828 ins., as against 29.850 ins. in 1930 and 29.842 ins. for the past 48 years. The highest pressure was 30.399 ins. at 9h. 15m. a.m. on January 9, as against 30.340 ins. in 1930 and 30.509 ins. for the past 48 years. The lowest pressure was 29.078 ins. at 5h. 0m. p.m. on August 16, as against 29.175 ins. in 1930 and 28.590 ins. for the past 48 years.

12. The temperature of the air was moderately above normal in February and November and moderately below in October. The mean temperature for the year was 72°.5, as against 72°.4 in 1930 and 71°.9 for the past 48 years. The highest temperature was 94°.0 at 3h. 47m. p.m. on August 25, as against 92°.9 in 1930 and 97°.0 for the past 48 years. The lowest temperature was 40°.3 at 7h. 18m. a.m. on January 10, as against 41°.2 in 1930 and 32°.0 for the past 48 years.

13. The rainfall was moderately above normal in April and September, and moderately below normal in June and July. It was considerably below normal in October and considerably above in December. A drought occurred from October 22 to December 6. During this period only 1.04 inch of rain occurred, of which 0.93 inch fell on November 11. 4.14 inches were measured from December 7 to 11, after which date no rain fell until 1932, February 4, except on December 26-7, when 0.41 inch was measured.

14. The total rainfall for the year was 80.39 inches as against 96.08 inches in 1930 and 85.50 inches for the past 48 years. The greatest fall in one civil day was 3.58 inches on December 9, as against 7.96 inches in 1930 and 21.02 inches for the past 48 years. The greatest fall in one hour was 2.55 inches at 9 p.m. on April 19, as against 2.36 inches in 1930 and 3.96 inches for the past 48 years.

15. The wind velocity was moderately above normal in April and considerably above in August (the greatest on record). It was considerably below in July (the lowest on record, except in 1916). The negative and positive waves of wind velocity in July and August corresponded to positive and

negative waves of atmospheric pressure. The mean wind velocity for the year was 12.4 *m.p.h.*, as against 10.9 *m.p.h.* in 1930 and 12.4 *m.p.h.* for the past 48 years. The maximum velocity for one hour, as recorded by the Beckley anemograph was 94 *m.p.h.* at noon on August 1, as against 66 miles in 1930 and 108 miles for the past 48 years. The maximum gust velocity, as recorded by the Dines-Baxendell anemograph, was at the rate of 136 *m.p.h.* from E.N.E. at 11h. 47m. a.m. on August 1, (the greatest on record) as against 83 *m.p.h.* in 1930 and 130 *m.p.h.* for the period 1910-30.

16. The relative humidity was considerably above normal in February and moderately above in May, September and December. It was moderately below normal in March, July and November and considerably below normal in October. The mean for the year was 79%, as against 78% in 1930 and 79% for the past 48 years. It frequently exceeded 95% in spring and summer. The lowest for the year was 29% at 0h. 45m. p.m. on March 13, as against 26% in 1929 and 12% for the past 48 years.

17. *Rainfall at five Stations.*—In the following table the monthly rainfall for the year 1931 at the Observatory is compared with the fall at the Police Station (*Tai Po*), the Botanical Gardens (*Hong Kong*), The Matilda Hospital (*Mount Kellet*), and Fanling.

Month.	Observatory (Kowloon).	Police Station (<i>Tai po</i>).	Botanical Gardens (<i>Hong Kong</i>).	Matilda Hospital (<i>Mount Kellet</i> , <i>Hong Kong</i>).	Fanling.
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	0.325	0.08	0.33	0.30	0.20
February,	0.550	1.02	0.74	0.55	0.87
March,	3.175	3.35	4.06	3.78	2.62
April,	8.930	18.43	8.90	9.30	16.12
May,	12.000	8.46	14.32	10.22	9.40
June,	11.600	23.91	12.14	6.98	15.26
July,	9.860	11.15	11.94	10.95	10.28
August,	14.270	11.88	13.64	13.54	12.84
September,	13.430	12.53	14.82	13.15	13.31
October,	0.730	2.87	0.66	0.47	0.52
November,	0.965	2.15	0.78	1.08	1.70
December,	4.555	5.55	4.83	4.71	4.19
Year	80.390	101.38	87.16	75.03	87.31

18. *Floods*.—The railway embankment at Shatin was washed away by floods on April 20.

The heaviest rainfall occurred at the Observatory as follows:—

Period 1931.				Amount. Inches.	Duration. hours.	Greatest fall in 1 hour.	
d.	h.		d.			Amount. Inches.	Time. d. h.
April.....	19 16	to	20 16	5.21	22	2.55	April...19 21
May	19 6	to	20 17	4.14	25	0.97	May ...20 2
June	22 22	to	26 12	7.17	31	0.89	June ...26 6
July	9 4	to	15 16	6.56	29	0.95	July ...15 14
Aug.	1 4	to	1 19	2.71	16	0.82	Aug. ... 1 15
Aug.	12 3	to	14 9	4.18	20	1.01	Aug. ...13 7
Aug.	16 0	to	17 13	4.07	33	0.51	Aug. ...16 18
Sept.	2 8	to	5 13	4.99	36	0.66	Sept. ... 2 21
Dec.	9 2	to	9 4	3.30	2	2.03	Dec. ... 9 4

The greatest fall in one minute was 0.83 inch at 12h. 12m. on May 31.

19 *Typhoons*.—The tracks of 19 typhoons which occurred in the Far East during the year 1931 are given in the Monthly Meteorological Bulletin for December.

20. A typhoon passing about 30 miles to the S.W. of Hong Kong, on August 1, produced a gust velocity at the Observatory of 136 m.p.h. from E.N.E. at 11h. 47m. The lowest barometer reading, reduced to sea-level and standard gravity, was 29.134 inches at 17h. on the 16th. A second, passing about 60 miles to the east of the Observatory, produced a strong gale at Gap Rock but only a fresh breeze at the Observatory. A third, passing between Gap Rock and Hong Kong on September 2, produced a gust velocity at the Observatory of 94 m.p.h. from S. by E. at 21h. 00m. The lowest barometer reading, reduced to sea-level and standard gravity, was 29.186 inches at 14h. 55m.

IV.—PUBLICATIONS.

21. *Daily Weather Report and Map*.—A weather map of the Far East, for 6 a.m. of the 120 meridian time, is constructed daily and lithographed at the Observatory. Isotherms have been included since March 6. On the verso of the map is printed the morning weather report, from 40 to 50 stations in China, Indo-China, Japan, Korea, Borneo and the Philippines, and a weather forecast for the following districts:—

1. Formosa Channel.
2. S.E. Coast of China between Hong Kong and Lamocks.
3. Hong Kong to Gap Rock.
4. S. Coast of China between Hong Kong and Hainan.

22. This publication is exhibited on notice boards at the Hong Kong and Kowloon Ferry Piers, the Harbour Office, at the offices of the Cable Companies and at the General Post Office. It may be purchased by the general public at a subscription rate of \$15 per annum. During the year 38 companies etc. subscribed for 48 copies. The weather report and forecast, and all storm warnings, are telephoned to Stonecutters Wireless Station for transmission to H.M. ships on the China Station.

23. A weather map for 2 p.m. of the 120 meridian time is also constructed daily. It is not published, but an evening weather report and forecast, based thereon, is sent to the morning papers and exhibited on the notice boards.

24. Meteorological observations made at the Observatory at 10 a.m. and 4 p.m. are published in the local press.

25. The emission in plain language of meteorological observations in the Far East ceased on May 31, and the following routine was substituted on June 1.

- (a) The 2200* observations from 20 stations, in the Far East are broadcast, in the 1929 International Code, at 0400 by Stonecutters Wireless Station (GYP) on short wave (8430 kcs) and simultaneously on long wave (113 kcs). Reports from ships and upper air observations are added.
- (b) The 0600 observations are similarly broadcast at 1200.
- (c) The synoptic message is followed by a "general inference" coded by means of the Non-Local Storm Signal Code, adopted at a Conference of Directors of Far Eastern Weather Services held at Hong Kong in 1930, with a few words in plain language if necessary.
- (d) Then follows a weather forecast for the five districts:—
 - Shanghai to Turnabout
 - Turnabout to Hong Kong
 - Hong Kong to Gap Rock
 - Hong Kong to Hainan Straits
 - North China Sea
- (e) Typhoon warnings are given in the "general inference".
- (f) The "general inference" and weather forecasts for the five districts are also broadcast in plain language by V.P.S. on 500 kcs. at 0400 and 1200 and repeated on 103 kcs. at 0500 and 1300.

*All times are G.M.T.

- (g) The “general inference” and a weather forecast for the district ‘Hong Kong to Gap Rock’ is broadcast in plain language by ZBW on 845 kcs. telephony at 0500 and 1200.
- (h) Storm warnings are broadcast by VPS on 500 kcs. and by ZBW on 845 kcs. telephony on receipt, and at the two subsequent hours. They are also broadcast as above at every hour when a typhoon is definitely threatening the Colony.
- (i) Shanghai and Manila storm warnings are broadcast by VPS on a 500 kcs. spark on receipt, and repeated after an interval of ten minutes. They are similarly broadcast by ZBW on 845 kcs. telephony when the Hong Kong local typhoon signals are hoisted.

V.—WEATHER TELEGRAMS, FORECASTS AND STORM WARNINGS.

26. *Daily Weather Telegrams.*—In addition to the ordinary 0600 and 2200 G.M.T. observations, which the Cable Companies transmit free of charge, the 0300 and 0900 observations were received at half rates from the following stations:—

Shanghai	Gutzlaff	Amoy	Macao.
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27. The 0700 and 2300 G.M.T. observations from Fort Bayard, Phu-lien, Tourane, Cape Padaran and Cape St. James, and the 0300 and 0900 G.M.T. observations from the above, and about 12 other stations in Indo-China, are received from Phu-lien on short wave. This service is very valuable and ensures the early receipt of the observations, and at regular hours, namely:—at 0115, 0400, 0830 and 1015 G.M.T. It also saves the expense of obtaining the 0300 and 0900 G.M.T. observations by cable.

28. Other valuable services are the 0600 and 2200 G.M.T. observations on 23 metres S.W. from Yangtze Ports, and several stations in N.E. China and Korea sent personally by Father Gherzi, S.J. of the Zi-Ka-Wei Observatory, and the 2100 G.M.T. observations from Pelew, Yap, Saipan and Ponape, sent on 286 kcs. from the Pelew Observatory at 0200 G.M.T.

29. The 0600 and 2200 observations from Hoihow are received by W/T occasionally.

30. The following new W/T services are much appreciated.

0600—2200 observations from Amoy, since February 2.

0300—0900—2100 observations from Taihoku, since June 8.

0600—2200 observations from Swatow, since July 3.

0600—2200 observations from Sandakan, since Aug. 1.

31. On October 28 the Director of the Weather Bureau of the Dutch East Indies announced that a wireless station had been erected at Tarempa, in the S. China Sea, and that meteorological observations from this station would be sent to Hong Kong in due course.

32. This service has been instituted at the request of the Hong Kong Government in connection with the supply of weather forecasts to aviators. No observations have yet been received.

33. I am informed that observers are being trained at Shanghai for a proposed meteorological reporting station on the Paracels; but no details as regards installation or date of opening such a station are to hand.

34. The Meteorological Authorities at Pratas continue to send, daily, with commendable regularity and promptitude, their 0300, 0600, 0900 and 2200 G.M.T. observations and the 2200 observations from some Philippine stations. They also send hourly observations during the passage of a typhoon.

35. *Extra Weather Telegrams.*—The following stations send extra weather telegrams at half rates during typhoons, on receipt of certain code words from Hong Kong:—Amoy, Canton, Macao, Phu-lien, Sharp Peak and Taihoku. The Director of the Philippine Weather Bureau also sends extra telegrams, at his discretion, from Aparri or some other station nearer the typhoon centre. On request, the Director of the Taihoku Observatory sends extra weather telegrams from the two stations in Formosa nearest to the centre during the passage of a typhoon.

36. *Weather Telegrams from Ships by Radio.*—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately):—

Month.	British (including H.M. Ships).				Other National- ities.		Total.		
	No. of ships.	No. of messages.	H.M. Ships in Port.		No. of ships.	No. of messages.	No. of ships.	No. of messages.	
			No. of ships.	No. of messages.					
January,	100	208	29	1176	66	110	195	1494	
February,	88	191	28	1001	44	76	160	1268	
March,.....	73	149	36	1191	46	66	155	1406	
April,	114	244	37	1074	51	82	202	1400	
May,	92	203	34	994	49	78	175	1275	
June,	183	444	45	611	54	100	282	1155	
July,	194	440	40	592	63	105	297	1137	
August,	217	504	46	639	76	126	339	1269	
September,	193	473	48	553	82	142	323	1168	
October,	227	540	42	605	107	185	376	1330	
November,	196	480	30	807	104	206	330	1493	
December,	150	300	29	855	87	156	266	1311	
Totals {	1931,	1827	4176	444	10098	829	1432	3100	15706
	1930,	1515	3117	414	8464	695	1234	2624	12815
	1929,	794	2549	310	1285	748	1982	1752	5816
	1928,	789	2645	203	1202	588	1893	1580	5740

37. It will be seen that the number of British ships sending these messages increased from 1929 in 1930 to 2271 in 1931. The number of ships of other nationalities increased from 695 to 829.

38. *Results of Weather Forecasts.*—The results of comparison of the daily weather forecasts with the weather subsequently experienced are given below, together with the results for the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1926	72	26	2	○
1927	70	26	4	○
1928	66	31	3	○
1929	70	28	2	○
1930	65	31	4	○
1931	67	30	3	○

39. The forecast comprises wind direction, wind force and weather. Complete success means correct in three elements. Partial success means correct in only two elements. Partial failure means correct in only one element. Total failure means correct in no element.

40. The method of analysis is described in the 1918 Report.

41. *Storm Warnings.*—The symbols of the China Seas Non-Local Storm Signal Code are displayed on Kowloon Signal Hill and on the roof of No. 49 Godown of the Hong Kong & Kowloon Wharf & Godown Co.

42 The following Ports are warned by a telegraphic adaptation of the code:—Shanghai, Sharp Peak, Swatow, Amoy, Santuao, Macao, Canton, Wuchow, Phu-lien, Taihoku, Manila, Labuan and Singapore. 146 storm warnings were sent in 1931. 134 were received from Manila and 181 from Zikawei. The corresponding numbers in 1930 were 111, 113 and 209 respectively.

43. No occasion arose to warn the Central Weather Bureau, Poona, of the passage of typhoons across Indo-China in a westerly direction.

44. No alteration in the arrangements for the display and dissemination of local Storm Signals was made during the year.

45. In the following table are given the number of times and number of hours the Local signals were hoisted in each of the years 1927-1931.

Year.	Warning Signal.		Signals 2-9		Signal No. 10 Bombs.
	Number of times.	Number of hours displayed.	Number of times.	Number of hours displayed.	Number of times fired.
1927	8	169	4	61	1
1928	1	10	2	58	...
1929	3	28	2	46	1
1930	5	88	3	37	...
1931	7	93	4	88	1

46. The figures in the above table include the number of and number of hours the Local signals were hoisted in each hoisted.

47. The warning signal indicates that a depression or typhoon exists which may possibly affect the locality. Signals 2-8 indicate that a gale is expected at Hong Kong. Signal No. 9 indicates that gale is expected to increase. Signal No. 10, accompanied by three bombs fired at intervals of 10 seconds, indicates that wind of typhoon force is anticipated.

VI.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, ETC.

48. *Logs received.*—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 134 ships operating in the Far East. These logs, representing 7,843 days observations have been utilised for amplifying the weather maps and verifying typhoon tracks. The corresponding figures for the 1930 were 192 and 10,273.

49. *Comparison of Barometers.*—The corrections to ships' barometers are usually obtained by comparing their readings while at Hong Kong with those of the Observatory Standard. Occasionally ship captains bring their barometers to the Observatory to be compared with the Standard.

VII.—MAGNETIC OBSERVATIONS.

50. From the beginning of 1928 magnetic horizontal force, declination and dip have been determined at the Au Tau Station weekly, when possible. The instruments used are a magnetometer by Cook, Troughton & Simms, No. 31, and an earth inductor by the Cambridge Instrument Co. C65818. In the following table are given the annual values of the magnetic elements in 1931 as derived from 52 determinations:—

Declination (West)	0°·43'·3
Dip (North)	30°·34'·4
Horizontal Force (C.G.S. Unit)	0·37522
Vertical Force (C.G.S. Unit)	0·22164
Total Force (C.G.S. Unit)	0·43574

51. From 1931 January 1, Greenwich Mean Time has been adopted for all magnetic observations and tabulations.

52. Records from the declination, horizontal force and vertical force instruments were obtained throughout the year with but minor gaps, due chiefly to the burning out of the electric recording lamps and occasional adjustments.

53. On January 19 new base-line mirrors, obtained from England, were fitted to the horizontal force and declination instruments. The mirrors were cemented to small brass plates held by light springs against three screws, which protrude through the back-plates of the magnet boxes of the two instruments. The base-line mirrors were aligned as closely as possible with the recording mirrors of the magnets, and the three screws were so spaced that suitable adjustment of the base-line mirrors could be made without difficulty.

54. The installation of the new base-line mirror has removed all anomalies in the value of the declination base-line; permitting satisfactory hourly tabulations of declination throughout the year. Values of the base line are given in the following table.

Values of Declination Base-Line Derived from the means of five consecutive weekly determinations.

January, ... ..22	74'2	July, 2	76'6
29	74'2	9	76'7
February, 5	74'3	16	76'8
12	74'2	23	76'8
19	74'2	30	77'0
26	74'1	August, 6	77'0
March,..... 5	74'4	14	77'0
12	74'6	20	77'0
19	74'8	27	77'1
26	74'9	September, 3	77'0
April, 2	75'0	10	77'1
9	75'1	17	77'2
16	75'3	24	77'1
24	75'7	October, 1	77'2
May, 1	75'7	9	77'1
7	76'0	15	76'9
14	76'2	22	76'8
21	76'4	29	76'8
28	76'5	November, 5	76'7
June, 4	76'5	12	76'8
11	76'6	17	76'8
17	76'6	24	76'7
25	76'5	December, 1	76'5
		8	76'3
		15	76'0
		22	75'7
		29	75'4

55. A time drift in the horizontal force and vertical force records, which appears to be due to a weakening of the quartz fibres rather than a reduction in the moment of the magnets, has made the determination of the temperature co-efficients a matter of great difficulty.

56. It is expected that a supply of alternating current from the mains of the China Light & Power Co. will be available about the middle of 1932. With this power it is hoped to keep the temperature of the recording room nearly constant. The time drift of both instruments can then be accurately determined.

57. Attempts to increase the sensitivity of the vertical force instrument failed, owing to the system becoming unstable before the desired sensitivity had been reached. On April 2 the magnet-system was removed from the instrument and

carefully examined. It was found that the magnets were appreciably asymmetrical with respect to the mirror. This was remedied with satisfactory results. On April 7, 10 and 28 attempts were made to eliminate the temperature co-efficient; but without complete success. The co-efficient has been greatly reduced, however.

58. The following table gives temperature data for the magnetograph room during the year 1931.

Month.	Temperature.			Daily Range.		
	Absolute.		Mean.	Maximum.	Minimum.	Mean.
	Maximum.	Minimum.				
	°	°	°	°	°	°
January,	74·3	60·5	67·7	5·5	0·8	1·2
February,	74·0	60·2	66·1	3·3	0·6	0·7
March,	75·0	63·1	69·1	4·2	0·1	1·2
April,	82·6	70·7	76·2	3·5	0·6	1·0
May,	87·4	80·3	83·1	2·5	0·7	1·1
June,	89·0	83·1	86·0	2·8	0·6	1·1
July,	90·7	85·8	88·7	2·2	0·9	1·3
August,	90·2	84·2	87·7	2·3	0·6	1·5
September, ...	89·6	82·0	87·2	3·7	0·8	1·3
October,	84·8	76·2	79·7	2·8	0·5	1·7
November,	78·4	73·0	75·6	2·7	0·2	1·3
December,	75·1	64·2	69·9	4·2	0·3	1·2

59. The following table shows the magnetic character of the year 1931 at Hong Kong.

Month Day.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1	0	0	1	0	1	0	0	1	1	0	1
2	0	0	1	0	0	2	1	0	0	1	0	1
3	0	0	1	1	0	1	0	1	1	0	0	1
4	0	1	0	1	0	0	0	0	1	0	1	1
5	0	0	0	0	1	0	0	0	1	1	1	1
6	0	0	0	0	1	1	0	0	1	0	1	1
7	0	0	1	0	1	0	0	1	1	0	1	0
8	0	0	1	0	0	1	0	1	1	0	1	0
9	1	0	0	1	0	0	0	1	1	0	0	0
10	1	0	1	1	0	1	0	0	1	0	0	1
11	0	0	0	1	1	1	0	1	0	0	0	1
12	0	0	1	0	0	1	0	0	0	0	0	1
13	0	1	1	0	1	1	0	0	0	...	1	1
14	0	1	1	0	1	1	1	0	1	0	1	0
15	1	1	0	0	1	0	1	0	1	0	1	0
16	1	0	0	0	1	0	0	0	1	0	1	0
17	1	0	0	1	0	0	0	0	1	1	0	0
18	1	0	0	1	0	0	0	0	0	1	1	0
19	0	0	0	1	0	0	0	1	0	1	1	0
20	1	0	1	1	0	0	0	1	1	0	0	0
21	0	0	1	0	0	1	0	1	1	0	0	0
22	1	0	0	0	0	0	0	0	0	0	0	0
23	0	0	1	0	0	0	2	0	1	0	0	1
24	0	2	0	0	0	0	1	1	1	0	0	0
25	1	1	0	1	...	0	1	1	0	0	0	1
26	1	1	1	1	1	1	1	1	1	0	2	0
27	1	1	1	0	1	1	0	1	0	1	0	0
28	1	0	1	0	0	1	1	1	0	1	0	1
29	1	...	0	0	1	0	0	0	1	2	0	1
30	0	...	0	0	0	0	0	0	1	2	0	1
31	0	...	0	...	0	...	0	0	...	1	...	1

0=clam. 1=disturbed. 2=very disturbed. ...=register failed.

VIII.—TIME SERVICE.

60. *Time Ball*.—The time ball on Kowloon Signal Hill is dropped at 10h. and 16h. daily, except on Saturdays when it is dropped at 10h. and 13h. and on Sundays and holidays when it is dropped at 10h. only (120th Meridian Time). The ball is hoisted half mast at the 55th minute and full mast at the 57th minute. If the ball fails to drop at the correct time it is lowered at 5 minutes past the hour and the ordinary routine repeated at the following hour, if possible.

61. Time signals are also given at night by means of three white lamps mounted vertically on the Observatory radio mast. The lights are extinguished momentarily every second from 20h. 55m. to 21h. except at the 28th, 29th, 54th, 56, 57th, 58th and 59th seconds, of each minute. The 21h. signals were repeated at midnight on December 31, the last signal indicating the close of the year 1931. The hours refer to Hong Kong Standard Time (8 hours east of Greenwich).

62. The time ball was dropped successfully 660 times. On August 1st at 10h. and 13h. and on September 2nd at 16h. the time ball was not raised owing to typhoon gales. The ball was not raised on December 11th at 16h. owing to an electrical fault.

63. The error of the time ball was 0s.5 on one occasion, 0s.4 on eleven occasions; on all other occasions the ball fell with an error of 0s.3 or less.

64. The probable error of the time ball in each month of the past five years is given in the following table.

Month.	Probable Error of the Time Ball,				
	1927	1928	1929	1930	1931
January,	±0·14	±0·13	±0·10	±0·10	±0·10
February,	·12	·10	·10	·13	·12
March,	·11	·10	·10	·12	·20
April,	·10	·10	·10	·16	·16
May,	·14	·10	·10	·15	·12
June,	·13	·20	·10	·14	·14
July,	·10	·11	·10	·10	·10
August,	·12	·20	·12	·12	·14
September,	·10	·11	·10	·10	·10
October,	·11	·11	·10	·11	·10
November,	·10	·10	·11	·10	·10
December,	·13	·12	·14	·10	·10
Means.....	±0·12	±0·12	±0·11	±0·12	±0·12

65. *Time Signals by Radio Telegraphy*.—In addition to the time signals given by the time ball, and on the radio mast, signals are broadcast at 10h. and 21h. by radio-telegraph, *via* Cape d'Aguilar. Particulars of the programme are given in Government Notification No. 322 of the 1st June, 1928.

66. Observations of the radio time signals emitted by Nauen at 8h. a.m. Hong Kong Standard Time, have been made daily, whenever possible, during the year. They have been utilised for clock regulation during cloudy weather.

67. *Transit Instrument*.—Routine transit and level observations were made by the Chinese computers throughout the year. The Collimation and Azimuth determinations, and occasional transit observations, were made by the Chief and First Assistants.

68. The number of observations in the years 1930 and 1931 were as follows:—

	1930	1931
Transits	1078	861
Level determinations	546	442
Azimuth determinations (mark)..	42	34
Azimuth determinations (transit of circumpolar stars)	238	164
Collimation determinations (mark)	47	38

69. *Clocks*—Sidereal Clock Cottingham and Mercer, No. 507, has been in use as the Observatory Standard throughout the year. Its performance was again marked by a steady increase of losing rate until September when the rate of increase became more rapid and the daily rate became unsteady. On October 12 the clock was dismantled for cleaning. The oil was found to have thickened in several of the pivot holes, but the pivots and teeth were in excellent condition. The electrical contact to actuate the remounting mechanism showed signs of wear and of sparking having taken place. The clock was re-assembled the same day and a new condenser placed across the terminals of the remounting contact. Its performance has since been very satisfactory. An increase of losing rate is again shown; probably due to a small leakage of the clock case.

70. The Leroy Mean Time Clock, No. 1350, was used for dropping the time ball, maintaining the electric time service in the Observatory, and sending hourly signals to the Railway, the Post Office, the Telephone Co., and the Eastern Extension Telegraph Co. The clock is corrected daily before 10h. and 16h. by the electric regulating apparatus. The daily rate of the pendulum is kept below 0.5s. by the addition or withdrawal of weights. The Dent Mean Time Clock, No. 39740, is held in readiness as a substitute for Leroy No. 1350. It was not required for this purpose in 1931.

IX.—MISCELLANEOUS.

71. *Seismograph*.—No alterations were made to the seismograph during the year. New needle points were fitted as required. 386 earthquakes were recorded during the year 1931 as against 320 in 1930. The seismograms have been forwarded to the President of the International Seismological Committee, Oxford, to be dealt with.

72. *Local Earthquake*.—An earthquake shock was felt at Hong Kong on September 21. No damage occurred. The origin was about 60 miles to the east of Hong Kong.

73. *Upper Air Research*.—356 balloon ascents were made during the year. 33 meteorological flights were made by officers of the R.A.F. Tephigrams were constructed from the observations thus obtained and the weather during the subsequent 24 hours noted thereon. It is hoped that a discussion of a large number of these tephigrams will be a considerable aid to weather forecasting in the future.

74. The results of the pilot balloon observations have been forwarded monthly to the Secretary of the International Commission for the exploration of the upper air.

75. The Washington Weather Bureau has been supplied, monthly, with Upper Air Wind Rose Data for 750, 1500 and 3000 metres above Hong Kong.

76. The following days were selected by the International Commission as days for International ascents:—February 9-14, June 15-20 and October 13-15. February was chosen as the "International Month". Balloon ascents were made on June 15-20 and October 13-15. The sky was completely overcast from February 9-14.

77. The Postmaster General was unable to accede to my request that watch should be kept for the experimental short wave emission from Paris on July 11, 18 and 28.

78. *Lithographic work*.—The following lithographic work was done at the Observatory for other departments.

- (a) Forms for temperature charts for the Government Civil Hospital.
- (b) Plan to accompany Game Licenses ordinance.
- (c) Plan of arrangements for Armistice Day celebrations.
- (d) Map of Hong Kong for the Dominions Office and Colonial Office List.
- (e) Maps of shipping routes for the Harbour Department, required in connection with draft rules relating to life saving appliances for passenger ships.

79. *Visitors.*—The Rev. Father Louis Froc. S.J. for many years Director of the Zikawei Observatory, passed through Hong Kong on August 18 on retirement, and was welcomed by the Rotary Club of Hong Kong. Mr. Ch'en Pin-jen, Director of the Meteorological station at Yunnan Fu, visited the Observatory on May 2. Parties of students from the Middle Light School, Canton, from the Y.W.C.A., Hong Kong, and from the Senior Class of the Central British School, Kowloon, visited the Observatory on April 10, May 30 and June 9, respectively.

80. *Staff.*—No change occurred in the European or Local staff during the year.

81. *Expenditure.*—The annual expenditure on the Observatory, for the past ten years has been as follows:—

Year.	Personal Emoluments and other Charges.	Special Expenditure.	Total Expenditure.	Total Revenue.
	\$ c.	\$ c.	\$ c.	\$ c.
1922	36,771.18	1,578.92	38,350.10	25.60
1923	38,495.23	27.35	38,522.58	116.20
1924	41,011.48	11,627.01	52,638.49	14.00
1925	41,955.51	...	41,955.51	79.20
1926	42,566.65	12,341.74	54,908.39	34.20
1927	47,253.17	145.24	47,398.41	30.50
1928	47,292.33	272.70	47,565.03	506.10
1929	48,282.63	...	48,282.63	530.50
1930	68,696.59	1,670.07	70,366.66	506.80
1931	76,037.81	...	76,037.81	735.00

82 In the following table the expenditure and revenue for 1930 is compared with that for 1931.

*Comparative Statement of Expenditure
1930 and 1931.*

	1930	1931.
Personal Emoluments	62,051.40	67,813.51
<i>Other charges.</i>		
Books and Postage	198.95	291.04
Electric Light & Power	389.45	648.28
Gas	89.97	77.06
Incidental Expenses	93.44	128.48
Laboratory Expenses	1,037.56	1,482.02
Meteorological Telegrams	967.97	755.72
Printing	2,570.50	2,887.25
Transport	111.08	125.06
Maintenance of Lithographic Plant	235.33	320.78
Maintenance of Time Service	93.16	87.35
Maintenance of Magnetographs	666.33	1,008.03
Uniforms	56.24	204.53
Subscription towards cost of printing International Upper Air Observations.	135.21	208.70
<hr/>		
Total Personal Emoluments & Other Charges	\$68,696.59	\$76,037.81
<i>Special Expenditure.</i>		
Renovation of Time Service Switchboard...	155.44	—
Meteorological Conference	1,514.63	—
<hr/>		
Total Department	70,366.66	76,037.81

*Comparative Statement of Revenue
1930 and 1931.*

	1930	1931.
Fees of Court or Office, Sale of Publications	506.80	735.00

83. *Acknowledgments.*—Acknowledgments are here made to the Naval Authorities for their co-operation in securing daily observations from H.M. Ships and for meteorological flights by officers of the R.A.F., to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs Authorities, for daily observations by cable and radio-telegraphy, and extra observations during typhoon weather; to the Telegraph Companies for transmitting the majority of the observations free of charge, to the Commanders of vessels who have furnished meteorological observations by post and by radio-telegraphy, to the Directors of the various Observatories and Institutions, and private persons, who have presented their publications to the Library, and to the Observatory staff for the efficient manner in which they have carried out their respective duties, particularly to Mr. B. D. Evans, First Assistant, who undertook much extra work during the absence on leave of Mr. C. W. Jeffries, Chief Assistant, from June 30 to February, 9, 1932.

T. F. CLAXTON,
Director.

16th February, 1932.

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REPORT OF THE DIRECTOR

OF THE ROYAL OBSERVATORY, HONG KONG,

FOR THE YEAR 1932.

I.—GROUNDS AND BUILDINGS.

Early in the year it was decided to build separate quarters for the Director, and to utilise the present quarters as additional office and library accommodation. Plans are in preparation and the work will probably be completed during the coming year.

II.—METEOROLOGICAL OBSERVATIONS.

2. As in former years, automatic records of the temperature of the air and evaporation were obtained with a Richard dry and wet bulb thermograph, and the direction and velocity of the wind with Beekley and Dines-Baxendell anemographs. Rainfall is recorded by a Nakamura Pluviograph, sunshine by two Campbell-Stokes universal recorders, and barometric pressure by a Marvin barograph. Eye observations of barometric pressure, temperature and cloud are made hourly, and the direction of cloud motion every three hours. Observations of pilot balloons are made with a Watts $1\frac{1}{2}$ inch prismatic theodolite at 9h. a.m. and 3h. p.m. when conditions are favourable.

3. The principal features of the weather in 1932 were:—

(a) A drought lasting from the beginning of the year until 3rd February.

(b) The absence of typhoons seriously affecting the Colony.

No measurable amount of rain fell between 28th December, 1931, and 3rd February, 1932, inclusive. The rainfall in October and November was also below normal. In spite of these dry periods, the total rainfall for the whole year was slightly above normal, owing to heavy rainfall in June and July.

4. The tracks of 21 typhoons which occurred in the Far East during the year 1932 are given in the Monthly Meteorological Bulletin for December. The only typhoons producing winds of gale force in Hong Kong were those of 21st July and 17th September. The first, passing about 150 miles to the south of Gap Rock, produced a gust velocity at the Observatory of 67 m.p.h. from E. at 21h. 19m. on 21st July. The second, passing on an almost identical track, produced a gust velocity at the Observatory of 79 m.p.h. from E.N.E. at 8h. 00m. on 17th September.

In the following table the monthly rainfall at the Observatory is compared with other records in the Colony.

Month.	Obser- vatory (Kowloon).	Police Station (Taipo).	Botanical Gardens (Hong Kong).	*Matilda Hospital (Mount Kellat, Hong Kong).	Fanling.
	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>	<i>inches.</i>
January,	0·000	0·00	0·01	0·04	0·00
February,	2·535	3·08	2·75	2·49	2·96
March,	2·200	1·16	1·83	1·57	0·64
April,	3·700	5·05	3·60	2·62	3·42
May,	2·510	3·81	2·22	0·95	2·30
June,	25·290	20·78	22·55	17·98	14·63
July,	25·710	26·33	27·58	21·50	19·86
August,	20·885	14·97	23·27	21·71	16·55
September,	4·340	4·89	4·42	4·14	5·66
October,	0·085	0·15	0·01	0·23	0·72
November,	0·100	0·60	0·04	0·13	0·80
December,	4·115	4·88	4·29	...	4·70
Year	91·470	85·70	92·58	...	72·24

* Record incomplete.

III.—PUBLICATIONS.

5. The results of the observations and records referred to in II (2) are published monthly in the Meteorological Bulletin. With the year under review this publication will cease and the results will be published in annual volumes,

A monthly abstract of meteorological observations is published in the Government Gazette and copies are supplied to any firm or individual requiring them, and a monthly seismological bulletin is issued and distributed to other observatories.

6. A weather map of the Far East for 6 a.m. of 120th meridian time, is constructed daily, and forecasts are issued for the following districts:—

A Shanghai to Turnabout.

B Turnabout to Hong Kong.

C Hong Kong and neighbourhood.

D Hong Kong to Hainan.

E Northern China Sea.

The map, weather report and forecast are exhibited at the Hong Kong and Kowloon ferry piers, the Harbour Office, Telegraph offices and the General Post Office. The weather map may be purchased by the public at a subscription rate of \$15 per annum. There were 41 subscribers in 1932. A weather map for 2 p.m. is also prepared, but is not published. Morning and afternoon weather reports and forecasts, together with observations made at 10h. a.m. and 4h. p.m., are published in the local press.

IV.—WEATHER TELEGRAMS, FORECASTS AND STORM WARNINGS.

7. The telegraph companies continue to transmit twice daily free of charge meteorological observations from Vladivostock, Japan, Shanghai, Formosa, Indo China and the Philippines. The number of meteorological broadcasts by radio is steadily increasing, and the direct radio services of Shanghai (sent personally by Rev. Fr. Gherzi, S.J.), Indo China, Formosa, Amoy, Swatow, Sandakan and Pratas Island are extremely valuable. Extra observations at half cable rate are also obtainable from a number of stations by the courtesy of the telegraph companies.

8. *Weather Telegrams from ships by Radio*:—The following table gives the monthly number of ships from which radio meteorological messages have been received, and the number of messages received (each arrival and departure is counted separately).

Month.	British (including H.M. Ships).				Other National- ities.		Total.		
	No. of ships.	No. of messages.	H.M. Ships in Port.		No. of ships.	No. of messages.	No. of ships.	No. of messages.	
			No. of ships.	No. of messages.					
January,	120	255	31	841	80	135	231	1231	
February,	122	216	24	531	59	93	205	840	
March,.....	119	195	18	137	64	109	201	441	
April,	131	192	15	125	55	91	201	408	
May,	120	200	14	137	65	102	199	439	
June,	186	302	16	126	63	115	265	543	
July,	150	283	8	125	72	120	230	528	
August,	110	178	12	110	63	113	185	401	
September,	127	250	11	116	80	125	218	491	
October,	145	252	18	168	91	150	254	570	
November,	118	218	14	149	67	125	199	492	
December,	86	151	11	139	72	127	169	417	
Totals {	1932,	1534	2692	192	2704	831	1405	2557	6801
	1931,	1827	4176	444	10098	829	1432	3100	15706
	1930,	1515	3117	414	8464	695	1234	2624	12815
	1929,	794	2549	310	1285	748	1982	1752	5816

9. Weather forecasts, storm warnings and time signals are distributed by radio telegraphy as detailed in the "Notice to Mariners" issued by this Department. Storm warnings to Hong Kong and vicinity are also given by means of the Local and Non-Local Signal codes. A telegraphic adaptation of the Non-Local Code is used for issuing warnings by cable to places outside the Colony.

10. The following table gives the results of the weather forecasts for the past 5 years. The methods of analysis are described in the 1918 Report.

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1927	70	26	4	0
1928	66	31	3	0
1929	70	28	2	0
1930	65	31	4	0
1931	67	30	3	0
1932	71	27	2	0

11. Local signals, day and night, have been hoisted during the past 5 years according to the following table.

Year.	Warning Signal.		Signals 2-9		Signal No. 10 Bombs.
	Number of times.	Number of hours displayed.	Number of times.	Number of hours displayed.	Number of times fired.
1928	1	10	2	58	...
1929	3	28	2	46	1
1930	5	88	3	37	...
1931	7	93	4	88	1
1932	8	101	5	104	...

V.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, ETC.

12. In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 112 ships operating in the Far East. These logs, representing 5,111 days observations, have been used for amplifying the weather maps and verifying typhoon tracks. The corresponding figures for 1931 were 134 and 7,843.

VI.—MAGNETIC OBSERVATIONS.

13. The following table gives the annual values of the magnetic elements in 1932.

Declination (West).....	0° 43' 16"
Dip (North).....	30° 33' 8"
Horizontal Force (C.G.S. Unit) ...	0.37545.

A detailed record of the results obtained at the Au Tau Magnetic Station during 1932 is now in the press.

VII.—TIME SERVICE.

14. The timeball is dropped at 10h. a.m. on Sundays and public holidays, 10h. a.m. and 1h. p.m. on Saturdays, and 10h. a.m. and 4h. p.m. on other days. Time signals are given from 8h.55 to 9h. p.m. each night by means of lights which are extinguished every second, except for periods marking the minutes and half minutes.

15. The timeball was dropped successfully 659 times. There was one failure, on 22nd April at 10h. a.m., when it fell 35 seconds early owing to an electrical fault. The ball was not raised on 8th April at 10h. a.m., owing to faults on the external line, and on 17th September at 10h. a.m. and 4h. p.m. owing to a typhoon gale.

The error of the timeball due to accumulated clock error did not exceed 0s.3 throughout the year.

16. Observations of the radio time signals emitted by Nauen at 8h. a.m. have been made daily, whenever possible, during the year, and utilised for clock regulations.

17. *Clocks.* Cottingham and Mercer 507 (Sidereal) and Leroy 1,350 were in use throughout the year.

Observations with the transit instrument for 1931 and 1932 are given in the following table:—

	1931	1932
Transits	861	1,007
Level determinations	442	512
Azimuth determinations (mark)...	34	16
Azimuth determinations (transit of circumpolar stars).....	164	216
Collimation determinations (mark)	38	42

VIII.—MISCELLANEOUS.

18. *Seismographs.* The seismographs have been kept in good order during the year. 430 earthquakes were recorded compared with 386 in 1931. The seismograms have been forwarded to the International Seismological Committee, Oxford.

19. *Upper Air Research.* Observations of 343 pilot balloons were made during the year and the results of meteorological ascents by the R.A.F. were communicated to the Observatory. It is hoped to complete an analysis of the upper air data collected from 1921 to 1932.

20. *Lithography.* A small amount of lithographic work has been done for the Colonial Secretary and the Government Marine Surveyor.

21. *Staff.* Mr. T. F. Claxton, Director since 1912 went on leave on 26th March, retiring from the service on 8th July. Mr. C. W. Jeffries was appointed Director and Mr. B. D. Evans Assistant Director on 9th July. The vacancy caused by these promotions was filled by the appointment of Mr. G. S. P. Heywood, B.A., B.Sc. (Oxon.) as Professional Assistant. Mr. Heywood arrived in the Colony and assumed duty on 10th August.

22. *Expenditure.* The annual expenditure on the Observatory, for the past 10 years has been as follows:—

Year.	Personal Emoluments and other Charges.	Special Expenditure.	Total Expenditure.	Total Revenue.
	\$ c.	\$ c.	\$ c.	\$ c.
1923	38,495.23	27.35	38,522.58	116.20
1924	41,011.48	11,627.01	52,638.49	14.00
1925	41,955.51	...	41,955.51	79.20
1926	42,566.65	12,341.74	54,908.39	34.20
1927	47,253.17	145.24	47,398.41	30.50
1928	47,292.33	272.70	47,565.03	506.10
1929	48,282.63	...	48,282.63	530.50
1930	68,696.59	1,670.07	70,366.66	506.80
1931	76,037.81	...	76,037.81	735.00
1932	69,518.23	...	69,518.25	598.00

23. In the following table the expenditure and revenue for 1931 is compared with that for 1932.

COMPARATIVE STATEMENT OF EXPENDITURE

1931 AND 1932.

	1931	1932
Personal Emoluments.....	67,813.51	61,360.31
<i>Other Charges.</i>		
Books and Postage	291.04	327.25
Electric Light and Power	648.28	586.54
Gas	77.06	106.28
Incidental Expenses.....	128.48	68.90
Laboratory Expenses	1,482.02	1,269.03
Maintenance of Lithographic Plant	320.78	269.28
Maintenance of Time Service.....	87.35	43.70
Maintenance of Magnetographs.....	1,008.03	816.28
Meteorological Telegrams	755.72	866.75
Printing	2,887.25	3,254.00
Subscription towards cost of printing International Upper Air Observations...	208.70	141.70
Transport	125.06	176.54
Uniforms	204.53	231.67
	<hr/>	<hr/>
Total Other Charges	8,224.30	8,157.92
Total Royal Observatory	\$76,037.81	69,518.23

COMPARATIVE STATEMENT OF REVENUE

1931 AND 1932.

	1931	1932
Fees of Court or Office, Sale of Publications	735.00	598.00

24. *Acknowledgements.*—Acknowledgements are here made to the Directors of the Weather Services of the Far East, the Chinese Maritime Customs, and the Commanders of all ships for the observations forwarded during the year, to the Telegraph Companies for continuing to forward observations free or at reduced rates, to all institutions and individuals who have contributed to the Library, and to the Observatory staff for the efficient performance of their duties during a year of many departmental changes.

C. W. JEFFRIES,

Director.

15th February, 1933.

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REPORT
OF
THE DIRECTOR
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FOR THE YEAR
1932

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